NOVEMBER • 1946

VOLUME XVIII NUMBER 2

the Petroleum Engineer

...ds for Operating Men

MEETINGS

December 2-6—American Society of Mechanical Engineers, New York.

December 4—New Mexico Oil and Gas Association, annual meeting, Artesia.

December 9—Nomads, Old College Inn, Houston, Texas.

December 9-11—Interstate Oil Compact Commission, Adolphus Hotel, Dallas, Texas.

December 11—Nomads, Mayfair Hotel, Los Angeles, California.

December 12-13—American Chemical Society, Texas sections, Dallas.

January 6-10—Society of Automotive Engineers, annual meeting and engineering display, Book-Cadillac Hotel, Detroit, Mich.

February 24-28—ASTM, Spring meeting, Benjamin Franklin Hotel, Phildelphia, Pa.

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MagniLastic OFFSET JOINTS

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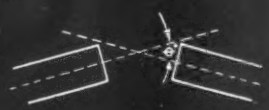
Wherever piping is installed, misalignment between adjacent terminals may exist. This can be due to accumulated tolerances in successive piping sections, to settling or shifting at anchored points and hangers, or to variations in operating conditions. In addition to "making ends meet", Offset Joints protect valves, headers and fittings from undue strain or tension due to misalignment.

SPECIFICATIONS FOR OFFSET JOINTS:

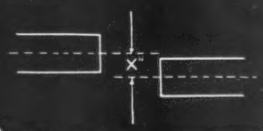
MagniLastic Offset Joints are supplied with bellows flanges from any of the standard MagniLastic Expansion Joint pressure series. These include vacuum to 25 psi Copper, 55 psi Monel, 150 psi, 400 psi, and 1000 psi Stainless Steel. Pipe sizes range from ½ to 24 inches. End fittings may be specified either Van Stone Standard flanges or welding ends. Length of unit and number of bellows flanges depends on offset condition to be corrected, but is easily calculated from data given in the catalog.

What Is Misalignment?

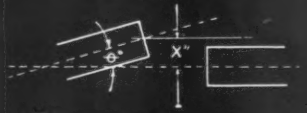
Three common conditions of misalignment in piping connections are:



1 LATERAL: Amount is specified in degrees, and correction made with standard MagniLastic Expansion Joints, allowing one bellows flange for each 2° of lateral deflection.



2 PARALLEL: Amount is specified in inches, and correction made with MagniLastic Offset Joints. Overall length varies with amount of offset.



3 ANGULAR: Amount is specified in both degrees and inches. Recommendations should be obtained from MagniLastic for correction of each condition.

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"LOCKING-IN" OIL RESOURCES

Hoarding of oil resources to meet a national emergency is fallacious. In an address before the American Petroleum Institute at Chicago, Eugene Holman, president, Standard Oil Company (New Jersey) had this to say:

"We in the oil business oppose waste. The goal of our research and development efforts is the more efficient use of our natural resources. Our industry has been foremost in urging the states to pass wise conservation laws. But 'locking up' natural resources in vast areas is not our idea of conservation. That is the best way *not* to have oil available for either present or future use. Our Federal and state lands should be open for large and small to prospect and to develop from them useful contributions to our civilization.

"In this connection, Professor Erich Zimmermann of the University of Texas has made an interesting distinction. Oil, iron ore, coal, and other materials merely known to be in the ground, he describes as 'neutral stuff.' They become 'natural resources' only after human effort and skill have been applied in rendering them accessible. Our economy is not served, either in peace or war, by the 'neutral stuff' we assume to be confined in the substrata of our continent. It is the availability of natural wealth that determines its industrial significance in peace and its strategic importance in war.

"The controversy between the Federal and State governments concerning the three-mile strip of tidewater land is not conducive to the development of possible oil resources in these areas. Their development will require years of exploring and drilling. Any decision to set aside the tidewater land as a 'salted down reserve' probably means that the oil would be unavailable in an emergency. The emergency would be over before the necessary wells could be drilled and production facilities installed. Up to the present time, the states have successfully dealt with situations involving their own coastal areas, and their decisions have been generally encouraging to industrial development.

"Similar considerations concern the Continental Shelf. It is perfectly clear that oil will become available in these areas only after active exploration has begun and machinery has been set up to ascertain their economic value. Setting aside the Continental Shelf as a reserve will not produce oil from it.

"People who maintain that oil reserves should be hoarded as a measure of national security apparently have the idea that we could go out overnight, tap our hoarded reserves, and have 100-octane gasoline the next morning. Actually, the amount of time required to bring an operation of this type into being runs into years. Had the great East Texas field been a static reserve at the time of Pearl Harbor instead of a producing field operated by the industry, the winning of the war would certainly have been delayed.

"Hoarding is not the answer. The best way we can promote our national security in oil is by maintaining a vigorous, flourishing oil industry, active and up-to-date in every department. True conservation is the intelligent development and use of resources; not non-use. We cannot sit and contemplate our oil resources as the French sat and contemplated their security behind the Maginot Line. Our oil economy is like a man on a bicycle. He must keep moving forward in order not to fall over."

Ralph T. Zook in his address before the American Petroleum Institute hinted at the detrimental effect of hoarding, stating that:

"The locking up of crude reserves for use in emergency would be dangerous and impractical for many reasons. Colonel G. H. Vogel, executive officer, Army and Navy Petroleum Board, has stated that the early military oil needs in case of a possible future emergency are indicated to be more than twice the peak requirements of World War II, or 2,600,000 bbl. daily. It required the entire petroleum reserves of 20,000,000-000 bbl. to produce approximately 5,000,000 bbl. daily during World War II. The demoralizing effect on our economy of locking up the billions of barrels of oil reserves necessary to supply a substantial part of the military requirements and the cost of protecting and observing the wells and otherwise keeping the properties in readiness for production without delay is too obvious to require comment."

"OPEN-DOOR" POLICY ADVOCATED

A simple, forthright statement that could well be the basis for a sound foreign oil policy was that made by J. Howard Pew, president, Sun Oil Company, in addressing the American Petroleum Institute at Chicago. He said:

"In the field of foreign oil our government has no reason to go beyond insisting upon non-discriminatory commercial treatment of all American oil marketers; upon the 'open door' principle of equal opportunity in exploration and development rights; and, upon just and adequate compensation for seizure of property by foreign governments. But our government should do exactly these things in respect to all Americans and commodities of trade through general treaties of amity and commerce.

"American oil asks no special privileges, at home or abroad. Neither do we want to be subjected to super-state cartels and other restrictive controls.

"We ask only the opportunity, both at home and abroad, to do business in the traditional American manner of competing with all comers, with none barred, on a basis of equal rights, without coercion or monopolistic restraints of trade.

"If we are permitted to proceed along that highway of spirited competitive enterprise, then all the bright hopes for our industry will be fulfilled and we shall multiply many times our past contributions to raising the standard of living and assuring the national defense of the American people."

—*K.C. S.*

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SCANNING WASHINGTON'S OIL HORIZON

By **MILBURN PETTY**

WASHINGTON—The 80th Congress will start grinding out good news for oil men soon after it convenes January 3 in the form of tax reductions, elimination of the remaining wartime controls and banishment of several bugaboos hovering over the industry for several years.

Federal Power Commission's ambition to extend its controls over natural gas to include production of both oil and gas was doomed as soon as the votes were counted. With the Republicans capturing both houses of Congress on a platform of fewer government controls, the GOP certainly won't go for any proposed legislation to extend FPC's authority. Indeed, there is a good chance that the Natural Gas Act will be amended now to declare specifically that FPC's authority does not include any control over production or "end use" of gas.

Not only is the oil and gas depletion allowance safe from attack by the Treasury Department (which was planning a new onslaught) but the time is ripe for a movement to eliminate the tax law provision that the 27.5 per cent deduction from gross income is limited to 50 per cent of the taxpayer's net income. This would provide the industry—especially the smaller producers—with more money for exploratory drilling, which is so earnestly sought by military authorities worried over our domestic reserves.

The military's views hold the key to whatever the Republican-controlled Congress may do in the way of oil legislation. From the Republicans' standpoint, the executive branch is made up of New Dealers hanging on until the Truman Administration is ousted in 1948. But the professional military men are to be excepted; their views carry weight with either Republicans or Democrats. For example, if a permanent price differential for stripper wells is to be enacted, as some producers propose, it will come only if the military says such a step is necessary to conserve our oil reserves.

The same holds true for the Anglo-American Oil Agreement, although its chances are slim at best, with a large segment of Southwestern producers opposing it. Still, the oil treaty's chances are better than if Senator Tom Connally, Texas, were to continue as chairman of the Senate Foreign Relations Committee.

Enactment of a tidelands quitclaim resolution seems assured now, if the Supreme Court decides in favor of federal claims to offshore submerged lands. And this holds, even if President Truman should veto it. The votes are there now to override him.

The last two surviving congressmen who sponsored pipe line divorcement bills—Voorhis of California and Izaac of California—were defeated on November 5.

There is likely to be an active interest in the small businessman, however, especially in the House. Congressman Ploeser, Missouri, may head the House Small Business Committee. Ploeser was a friend of the independent producers when they were seeking higher crude prices from OPA. He has been a severe critic of tax exemptions for cooperatives—but consideration for the Republican hopes for 1948 may prevent him from antagonizing the farmers at the coming session.

Congressman Wolverton, New Jersey, a member of the original congressional oil committee of 1934—the Cole Oil Committee—probably will continue the oil subcommittee when he takes over as chairman of the House Interstate Commerce Committee. The Cole Committee won the respect of the industry as it visited all the important oil areas of the country. But it has been relatively inactive since Cole retired as a congressman from Maryland to accept a federal judgeship.

At least two of the new members of Congress will be fresh from the oil industry—and both were associated with the same company, Socony-Vacuum. James P. Kem, Kansas City, is the Senator-Elect from Missouri while Howard Coffin has been elected a congressman from Detroit.

In the industry, the most powerful man, politically, now undoubtedly is Walter S. Hallanan, Plymouth Oil Company, who is Republican National Committeeman from West Virginia. He is temporary chairman of the National Petroleum Council.

● **MILITARY OIL.** The military will set up a top-flight oil industry advisory committee of its own, if Interior Secretary Krug does not soon appoint a military oil subcommittee of the National Petroleum Council. With an estimate that military oil requirements in event of another war will amount to more than twice the peak demand of World War II, the Army-Navy Petroleum Board is anxious to sit down with industry leaders and work out plans for providing the productive capacity to meet such demand.

● **AIRCRAFT FUELS.** Acting Director Davies of OGD is being pressed to set up a technical subcommittee of the National Petroleum Council to study the availability of military aircraft fuels, with special emphasis on jet fuels. It is probable that regional committees will also be set up as was done under the aviation gasoline program during the war.

● **STRIPPER WELLS.** Some government officials would like to cut another nickel off the stripper well subsidy before Congress meets in January, just to show the economy-minded Republicans that their heart is in the right place.

● **GAS IN ELK HILLS.** Several knotty legal tangles will have to be solved, if the Navy decides to allow Southern California Natural Gas Company to store gas in Elk Hills Naval Petroleum Reserve. The California company wants a place to put any excess gas from West Texas received during the slack season via the transcontinental line now being built. Company would "pay" for this by withdrawing only 90 per cent of the volume of gas injected.

● **MID-EAST OIL.** Arabian-American Oil Company's obtaining of the contract to supply 787,500 bbl. of Arabian crude to UNRRA for Italian refineries at $1.13 FOB Ras Tanura has been accepted by British oil interests as a challenge and they are now out to grab any business they can in the Mediterranean and Far East.

● **OGD.** Max W. Ball, well-known petroleum engineer and author, is considering Interior Department's offer of the post of Director of the new Oil and Gas Division. (He was Interior's first choice last spring, but was unable to accept because of previous commitments as a consultant so the job was not offered to him then.) Alec W. Crowell, Mississippi, is slated to be chief of OGD's conservation and reserves branch.

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national petroleum situation

By H. J. STRUTH,* *Petroleum Economist*

REFINED STOCKS HIGHER. While demand for crude oil continues to exceed seasonal expectations, stocks of refined products are increasing at rates which fail to sustain the need for present rates of production and refining operations. October additions to storage exceeded 13,000,000 bbl., which brought total refined oil stocks to a level that is nearly 60,000,000 bbl. above a year ago. Motor fuel stocks are 18 per cent above last year, while fuel oil stocks have increased 40 per cent.

*Editor, *The Petroleum Data Book.*

PRODUCTION CUT-BACK. Daily production of crude in October was 4,731,000 bbl., which represents a cut-back since August of about 132,000 bbl. Cumulative production in first 10 months of year is shown to have been within actual market requirements. However, the facts show that runs to stills by refiners have exceeded normal market requirements by more than 70,000 bbl. daily. This has created a heavier demand for crude, but has in turn resulted in substantially greater additions to stocks than might normally have been experienced.

DRILLING MORE ACTIVE. Well completions this year are 7 per cent above last year. The outlook for 12 months is a total of 28,500 wells drilled, against 27,700 in 1945. Preliminary figures indicate this year's total drilling footage will be over 100,000,000 feet of holes drilled, which will comprise over 70,000,000 feet of rotary and over 30,000,000 feet of cable tool drilling. The price boosts provided the needed stimulus.

WILDCAT GAINS. Comparison of wildcat drilling figures for some states with last year shows that Oklahoma, Louisiana and Illinois have materially stepped up the search for new fields. Offsets to these gains, however, were substantial declines in wildcat drilling by Kansas, New Mexico and Mississippi. Texas continued to lead the nation in the search for new oil fields by drilling 1,324 wildcats in the first 10 months, which represented an increase over last year of about 2 per cent. Total U. S. wildcat operations this year will exceed 4200, against 4100 last year.

Comparative Statistics, October, 1946

*All figures are computed on a Bureau of Mines' Basis**

	October 1946(p)	Sept. 1946(p)	October 1945	This year to date	Last year to date	Per cent change
Wells drilling	4,075	¶3,975	4,130	4,075	4,130	— 1
Total wells drilled	2,520	2,577	2,286	23,847	22,368	+ 7
Development wells	2,150	2,179	1,918	20,371	18,924	+ 8
Oil	1,285	1,285	1,134	12,469	11,531	+ 8
Gas	281	303	241	2,375	2,110	+13
Dry	584	591	543	5,527	5,283	+ 5
Per cent dry	27.2	27.1	28.3	27.1	27.9	— 0.8
Wildcat wells	370	398	368	3,476	3,444	+ 1
Oil	67	64	48	512	459	+12
Gas	11	8	7	99	113	—12
Dry	292	326	313	2,865	2,872	0
Per cent dry	78.9	81.9	85.0	82.4	83.4	- 1.0
Crude production	146,650	143,580	132,597	1,440,478	1,437,356	0
Daily average	4,731	4,786	4,277	4,738	4,728	
Crude demand‡	157,550	151,880	138,848	1,511,358	1,497,466	+ 1
Daily average	5,082	5,063	4,479	4,972	4,926	
Crude stocks	225,650	228,550	225,852	225,650	225,852	0
Days supply	44	45	50	44	50	
Natural gasoline production	9,580	9,440	9,027	94,118	92,409	+ 2
Daily average	309	315	291	310	304	
Motor fuel production	68,950	66,200	60,604	642,515	666,128	— 4
Daily average	2,224	2,207	1,955	2,114	2,191	
Gasoline yield, per cent	41.4	40.3	40.3	39.3	40.8	— 1.5
Motor fuel demand‡	67,380	67,940	58,185	650,591	673,911	— 3
Daily average	2,174	2,265	1,877	2,140	2,217	
Motor fuel stocks	85,300	83,730	71,998	85,300	71,998	+18
Days supply	39	37	38	39	38	
Fuel oil production	59,230	58,650	55,461	602,879	601,030	0
Daily average	1,911	1,955	1,789	1,983	1,977	
Fuel oil demand‡	54,080	50,940	60,468	607,689	652,277	— 7
Daily average	1,745	1,698	1,951	1,999	2,146	
Fuel oil stocks	122,450	112,900	87,547	122,450	87,547	+40
Days supply	70	66	45	70	45	
Refinery still runs	148,050	144,930	131,567	1,442,495	1,439,050	0
Daily average	4,776	4,831	4,244	4,745	4,734	
All refined stocks†	296,800	283,500	237,021	296,800	237,021	+25
Days supply	61	58	50	61	50	

Economic Position of U. S. Petroleum Industry

Ten Months Ending October 31, 1946

	Normal	Actual	Per cent of normal
Drilling*** (wells completed)	22,800	23,847	105
Production (daily crude output)	4,728	4,738	100
Refining (daily still runs)	4,671	4,745	102
Stocks (crude and refined)†	490,025	522,450	107
Price of crude (per bbl.)	$1.88**	$1.56	83

Crude Prices by States for October, 1946

U. S. average	$1.56	Louisiana	$1.57
Texas	1.56	Arkansas	1.38
California	1.41	New Mexico	1.35
Oklahoma	1.58	Mississippi	1.37
Kansas	1.57	Illinois	1.74
		Other states	2.20

Basic crude prices

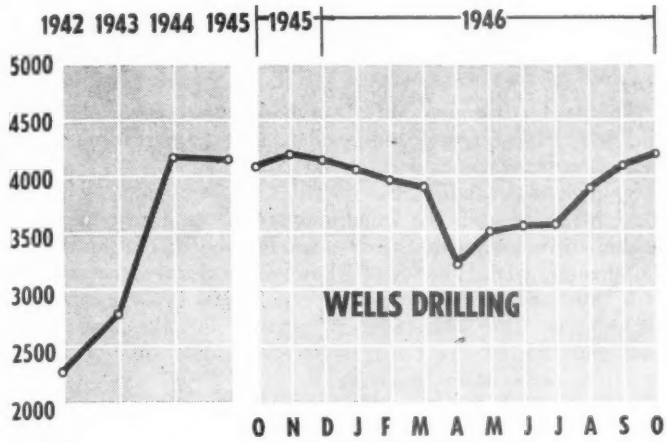
Oklahoma-Kansas (36 gr.)	$1.62
Texas Gulf Coast (36 gr.)	1.75
East Texas	1.60
West Texas (36 gr.)	1.39
Calif. Signal Hill (26 gr.)	1.46
Pennsylvania, Bradford	3.10

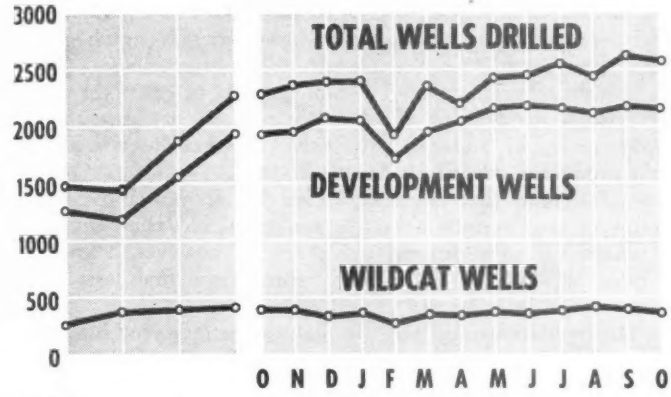
Drilling and Production Statistics by States

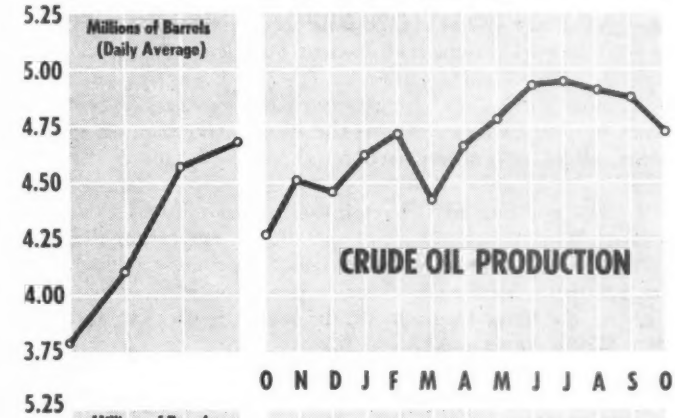
	October 1946(p)	Sept. 1946(p)	October 1945	This year to date	Last year to date	Per cent change
Total wells drilled	2,520	2,577	2,286	23,847	22,368	+ 7
Texas	624	652	576	6,575	5,889	+12
California	84	81	183	1,303	1,902	—31
Oklahoma	326	307	155	2,377	1,979	+20
Kansas	159	170	157	1,634	1,438	+14
Louisiana	140	130	93	1,135	930	+22
Arkansas	13	18	18	145	143	+ 1
New Mexico	50	47	46	345	351	— 2
Mississippi	24	24	39	210	313	—33
Illinois	228	258	157	1,970	1,478	+33
Other states	872	890	862	8,153	7,945	+ 3
Wildcats drilled	370	398	368	3,476	3,444	+ 1
Texas	135	148	120	1,324	1,296	+ 2
California	29	20	30	203	208	— 2
Oklahoma	67	43	27	421	381	+10
Kansas	16	28	33	239	314	—24
Louisiana	20	26	12	210	142	+48
Arkansas	3	5	4	33	33	0
New Mexico	4	5	14	38	74	—49
Mississippi	4	6	11	60	108	—44
Illinois	60	65	35	425	304	+40
Other states	32	52	82	523	584	—10
Daily crude production	4,731	4,786	4,277	4,738	4,728	0
Texas	2,049	2,089	1,750	2,082	2,098	— 1
California	871	871	827	862	905	— 5
Oklahoma	346	356	369	370	376	— 2
Kansas	279	280	262	266	266	0
Louisiana	406	401	356	388	356	+ 9
Arkansas	77	77	75	77	79	— 3
New Mexico	102	103	97	100	103	— 3
Mississippi	75	73	52	63	51	+24
Illinois	202	207	206	207	205	+ 1
Other states	324	329	283	323	289	+12

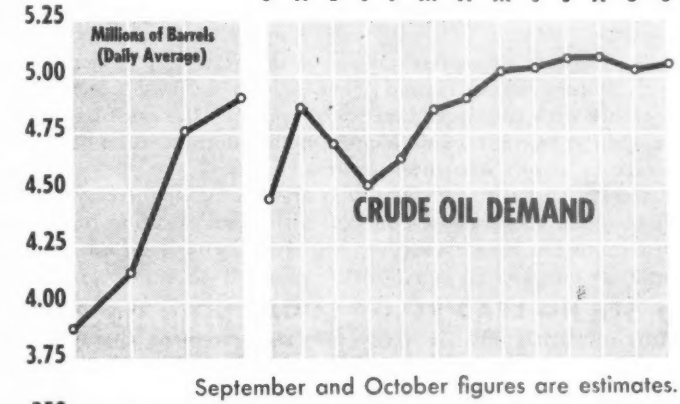
*Unless otherwise stated all figures represent thousands of barrels. ***Does not include input wells. (p) Preliminary
‡Total demand, including exports. ¶Revised. **Price 1926 (Index 100) †Includes natural gasoline stocks.

PRELIMINARY ESTIMATES BASED UPON DATA FURNISHED BY AMERICAN PETROLEUM INSTITUTE, U. S. BUREAU OF MINES, STATE AGENCIES AND OTHER OFFICIAL SOURCES.

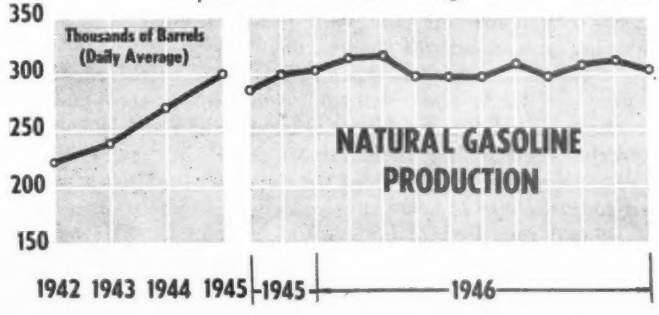


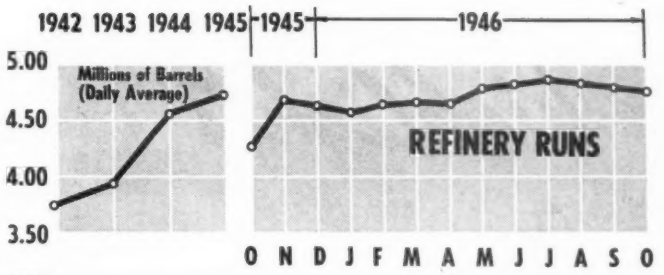


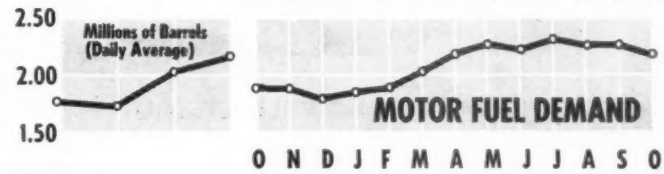


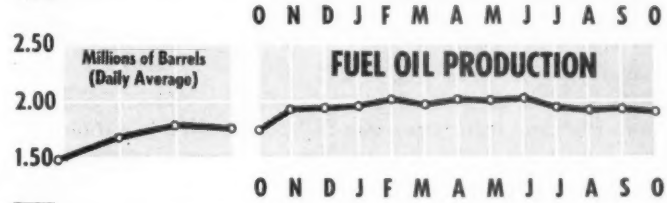


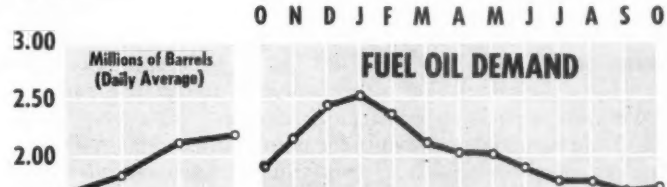
September and October figures are estimates.

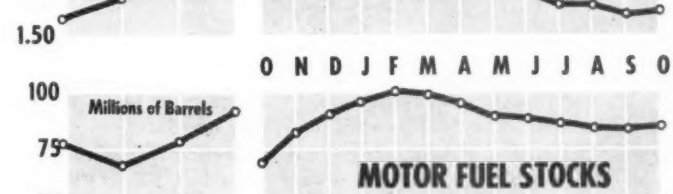


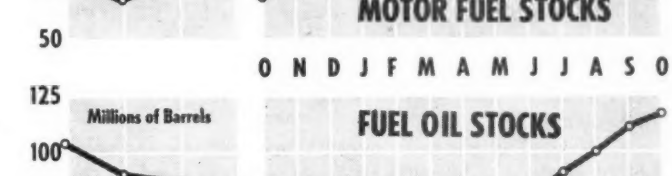




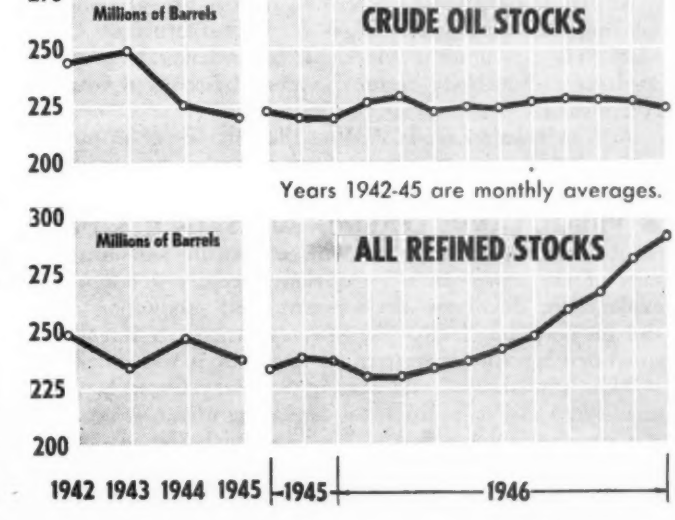








Years 1942-45 are monthly averages.



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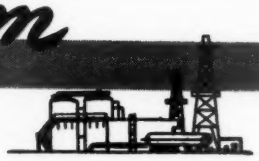

● **OKLAHOMA DRILLING RULES.** The Oklahoma Corporation Commission recently announced changes in its general rules governing the drilling and production of oil and gas wells in the state. The new order, No. 19,334, was issued after several months' study.

In general, the amendments were adopted to bring commission rules and regulations into full accord with proration laws enacted by the 1945 legislature. One requirement of the general orders left unchanged, however, was the provision that operators seeking to drill a well closer to lease lines than 165 ft. for tests shallower than 2500 ft. and 330 ft. for deeper tests must apply to the commission for an exception to the rules and present their application in a formal hearing.

This requirement accounts for numerous hearings appearing on an always crowded corporation commission proration docket.

Chairman Reford Bond of the commission announced these principal features of the new order:

1. For reporting purposes, only the figure of 14.65 should be used instead of 16.4 as a measurement of gas.

2. Definitions of waste of oil and gas were changed to agree with the definitions provided for by house bill 257 of the last Oklahoma legislature.

3. Filing of electric logs with the corporation commission is required on wells drilled when and if they are released for publication.

4. New oil or gas wells may be produced not to exceed 150 bbl. of oil daily or 500,000 cu. ft. of gas daily pending the time that the wells are classified and the allowables are fixed.

5. Rules and regulations are provided governing the underground disposal of salt water setting out in detail the information to be supplied to the commission before permits may be issued.

6. Heretofore there have been no rules and regulations prohibiting the use of natural gas for manufacture of carbon black. The new order provides that before natural gas may be used for carbon black permission must be received from the commission.

7. New rules are established for the plugging of seismic and core holes in order to protect fresh water oil or gas bearing sands.

● **PUBLIC LANDS LEASING RULES.** The U. S. Department of the Interior late in October formally announced details of the more liberal regulations recently developed for exploration, discovery, development, and production of oil and gas on public lands. The new regulations are intended to speed development of western oil resources, it was stated.

"The regulations," said Acting Secretary Oscar L. Chapman, "in a real sense mark the beginning of a new era in oil and gas development in the West in which the government and both large and small operators in the industry can work in closer cooperation and with greater incentive than before in the production of an adequate supply of this vital national asset."

The changes set more liberal standards for acreage holdings, and for rates of rental and royalty. For the first time they include options for exploration of land.

Some of the changes are:

1. An increase in the amount of public land that may be held in any one state to 15,360 acres. Previously, the limit was 7,680 acres of land outside of a known geological structure.

2. Authority for geological or geophysical explorations for oil and gas through a system of options. For the first time, non-renewable two-year options may be held on 100,000 acres in any one state at any one time.

3. More favorable rental charges and reduced royalties as an incentive to new discoveries and production of oil and gas. Previously, production from leased public lands was subject to the payment of a royalty to the government ranging from 12½ per cent to 25 per cent with additional graduated royalties on actual production. The new regulations grant the government a flat royalty of 12½ per cent on any production under leasing of lands not within the known productive limits of a producing deposit on August 8, 1946.

4. Provision that any lease issued for an initial five-year term for land outside a known geological structure may be extended for an additional five years. If, however, a known geological structure is discovered during the first lease, the renewal will be restricted to two years.

The regulations also provide that the secretary of interior, upon application of interested parties, may authorize the subsurface storage of oil or gas on public lands to prevent waste.

● **PACT OPPOSITION DEFINED.** Russell B. Brown, general counsel for the Independent Petroleum Association of America, has issued a statement from Washington since the Fort Worth meeting, discussing that organization's change from support to opposition to the Anglo-American oil agreement. IPAA opposition involves three chief factors, Brown said:

1. The wording of the resolution of disapproval as passed at Fort Worth was susceptible of the interpretation that all the advisers who aided in negotiation of the present treaty were not satisfied with the construction placed on it by representatives of the State Department. It now appears that some of the advisers entertained no such views.

2. Some in the industry have never approved the treaty but have not heretofore expressed their disapproval in IPAA meetings.

3. The talk of representatives of the State Department as well as remarks of Harold Ickes, former interior secretary, together with certain administration policies, has caused grave concern as to what would happen in the administration of the treaty by people who entertained such views.

Brown said that to those who are against any treaty has been added those whose concern with administration of the provisions has been aroused by various statements from government officials.

● **SEE NO LEAD RELIEF SOON.** Civilian Production Administration officials have made the statement that little effect on current shortages in tetraethyl lead or in the octane ratings of gasoline can be anticipated as result of 20,000 additional tons of metallic lead expected for the entire lead industry for the remainder of the quarter.

At the same time, Lawrence Brown, head of the chemicals division of CPA, said the 11,000-ton allotment of lead for tetraethyl fluid for the fourth quarter will not be changed, and that there is little indication of relief until late 1947.

The third quarter allocation for the entire lead manufacturing industry was 232,000 tons, which proved an overestimate of 40,000 tons beyond lead actually available. Half of this may be made up this quarter, however, with the 20,000 additional tons already in sight beyond the 212,000-ton allocation.

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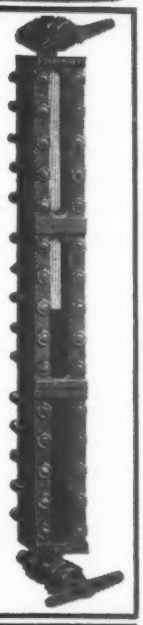
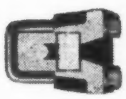
DROP FORGED STEEL LIQUID LEVEL GAGES



Liquid always shows black—empty space shows white. Preferred where the liquid level must be easily and positively visible, and when liquids are under high pressure or at high temperature. Made of alloy temperature resisting steel and are highest quality throughout. Liquid chamber made from solid block of steel to assure perfect alignment and rigidity. Conform with A.P.I.—A.S.M.E. requirements.

The "Reflex" is one of the complete line of Penberthy Gages that meet every liquid level gage requirement.



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WATER GAGE SET

For oil field, locomotive type and marine boilers. Water shows black—steam shows white; the water level is unmistakable. U-Bolt construction is strongest and simplest to service. Glass replaced by simply removing nuts on face of gage . . . unnecessary to work between gage and boiler. Conforms with A.S.M.E., Federal and State requirements when used for pressures specified by their respective codes.

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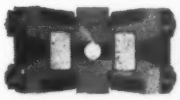
The "Transparent" is one of the complete line of Penberthy gages that meet every liquid level gage requirement.



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Used wherever seepage water accumulates, the Penberthy Automatic Electric Sump Pump and the Penberthy Automatic Drainer (water or steam operated) have demonstrated their superiority in this service. Simple and rugged design—copper and bronze construction throughout.

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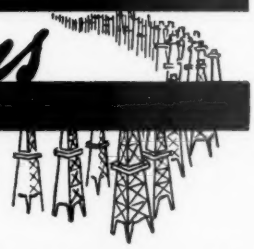
current oil field operations



● **OKLAHOMA.** J. J. Fleet and C. W. Roodhouse No. 1 Ball, NE NE NW 10-18n-3e, northwest of the Mehan pool and south of Stillwater, has opened a new pool in Payne County with 40 bbl. a day. Production is from the Bartlesville sand at 3920-54 ft.

D. H. Bolin No. 1 Collins, SW SW SW 33-2s-9w, 8 miles east of Walters had sand at 2,157-73 ft. and 2,210-24 ft., which showed saturation in samples and a good kick on electric log. Total depth of the well is 2,608 ft.

Carter Oil No. 1 Burford, C NW NW, 5-1n-1w, Gavin County, flowed 417 bbl. of oil in 24 hours through 3/8-in. choke with 560,000 cu. ft. of gas. It was flowing on test from perforations at 6,072-86 ft.

Sam Rhoades and Smith-Horton Drilling company No. 1 Letka, NE NE NE 32-8n-7e, which a week ago showed for a new discovery well in the Cromwell sand at 3,272-89 ft., after showing both oil and gas on a short drillstem test, drilled out the cement plug and it flowed an estimated 7 to 8 bbl. an hour along with 1,500,000 ft. of gas.

● **MISSOURI.** Mrs. Gladys Waymire No. 1 Stubblefield, NW SE SW 31-37n-32w, Vernon County, was completed at total depth of 2,325 ft. Mississippian was extended from 206 to 585 ft. The top of Jefferson City (Arbuckle) lime was at 585 ft.; and top pre-Cambrian granite, at 1440 ft.

● **KENTUCKY.** Carter Oil Co. No. 1 Adams, NW SE SW 4-N-23, had the Cypress sand at 2226-46 ft., total depth 2253 ft. The well flowed 283 bbl. of oil in 24 hours and has been pinched to 100 bbl. daily. It is a mile from the Poole field.

● **KANSAS.** The Texas Company No. 1 Dreiling, SW SW SW 15-13-17w, 2 miles south of the Catherine pool of Ellis County, found saturated Arbuckle lime at 3460-83 ft., and a 15-minute drillstem test yielded 1000 ft. of oil.

● **TEXAS.** A new Strawn pay area for Young County was seen assured recently at a wildcat two miles southeast of Living, being drilled by H. W. Snowden, Dallas, as No. 1 D. L. Shephard, 1950-TE&L. When plug was drilled from pipe set on Knox sand at 3006-18 ft., total depth, the well cleaned itself through casing, and was last reported flowing. There was no estimate on production.

An Edwards lime pool for Madison County has been opened by the West Production Company and Noranda Oil Company No. 1 Boring, to flow 39 bbl. of 55.8 gravity condensate daily, along with 1,053,000 cu. ft. of gas. Well is producing from the lime from 9495-9570 ft. and from 9615-9630 ft. at plugged back total depth of 9635 ft. The test was carried to 12,316 ft. but found no commercial production below the present formation.

A new Caddo pool strike for Throckmorton County had been made definite Friday as Konrad Sztygold No. 1 Curtis Richardson, 2083-TE&L, nearly seven miles north of Throckmorton, was brought in to flow 115 bbl. of oil in three hours following treatment with 1000 gal. of acid through perforations at 4640-50 ft.

Atlantic Refining Company has opened deeper production, about 2000 ft. deeper than the discovery, with the completion of the south producer for the South Hyatt pool of Tyler County. The new producer is the No. 1 J. R. Dempsey, L. A. Beard survey, which flowed a potential of 379 bbl. of 49.9 gravity condensate along with 4,235,000 cu. ft. of gas. Production was from perforations from 10,232 ft. to 10,272 ft.

An extension of more than three miles northwest and discovery of a new producing sand in the Dan Sullivan gas condensate reservoir of Brooks County highlighted operations on the South Texas border Saturday. The extension was recorded at Sun No. 6 Sullivan, Loma Blanca y El Tule grant. From sands at 10,155-80 and 10,275-80 ft., it rated 21,000,000 ft. of gas on open flow. Condensate output was 102 bbl. daily through choke.

● **MICHIGAN.** Panhandle Eastern Pipe Line Company No 1 McPherson, NW SW SE 34-3n-4e, Livingston County wildcat, logged an estimated 7,000,000 ft. of gas in the Salina lime between 3843-3900 ft., indicating an important gas field discovery in southern Michigan.

● **WYOMING.** The British American Oil Production Company wildcat has opened the Amsden formation as a fifth producing horizon in the Steamboat Butte field of Fremont County. It is BA's No. 6 Tribal, NW NE NW 5-3n-1w, which had drilled about 200 ft. into the Madison limestone without a show of oil. The saturation in the Amsden has not been thoroughly tested. It was reported drilling below 7734 ft.

● **INDIANA.** Calvert & Willis No. 1 Fred Wiley, wildcat in SW SW NE 18-5s-13w, Posey County, was completed in the McClosky at 2974-84 ft. and 2994-3003 ft., total depth. The well produces 225 bbl. of oil per day on the pump.

● **LOUISIANA.** Barnsdall Oil Company has discovered a Cockfield sand oil pool in Beauregard Parish, which may develop into one of the largest producers from this formation in the state. The No. 1 Long Bell Lumber Co. on a drillstem test of the sand at 8,262 ft. yielded 600 ft. or 20 bbl. of 46 degree gravity oil in 20 minutes. Engineers and production men estimate the well may be good for 1800 bbl. of oil a day when copleted.

● **MISSISSIPPI.** Production in Mississippi lime for Glasscock County on the east platform of the West Texas Permian Basin has been opened by Shell Oil Co., Inc., with No. 1 Clark, Section 5, Block 32; T-4s, T&P survey, eight miles northeast of Garden City. The well was completed to flow 238 bbl. of 56 gravity oil and 15 bbl. of salt water. Production is from 9740-65 ft. The well was treated with 500 gallons of acid.

● **ILLINOIS.** Texas Company is making a further test of its No. 1 E. E. Hines "C" SE SE SE 1-1s-9e, about 4 miles southwest of the Bennington oil pool. The formation is the Rosiclare from 3254-62 ft., with the total depth of the hole at 3262 ft. On a 14-hour swab test the well made 425 bbl. of oil.

J. W. Rudy No. 1 DeWhirst, SE NE SE 16-5n-9e, pumped 54 bbl. of oil and 59 bbl. of water a day from the Rosiclare at 3109-27 ft., to open a new pool in Jasper County.

McCummins Oil No. 1 Updike, SW SE 25-5n-13w, swabbed 20 bbl. of oil in 24 hours from the McClosky at 1721-27 ft.; still cleaning out and testing.

● **INDIA.** In the report of Attoch Oil Company for last year is news of a new oil field 12 miles from Joya Mair. Initial production was 350 bbl. a day from 8200 ft. Output has had to be limited to tankage and tests have not been thorough.

DOWELL

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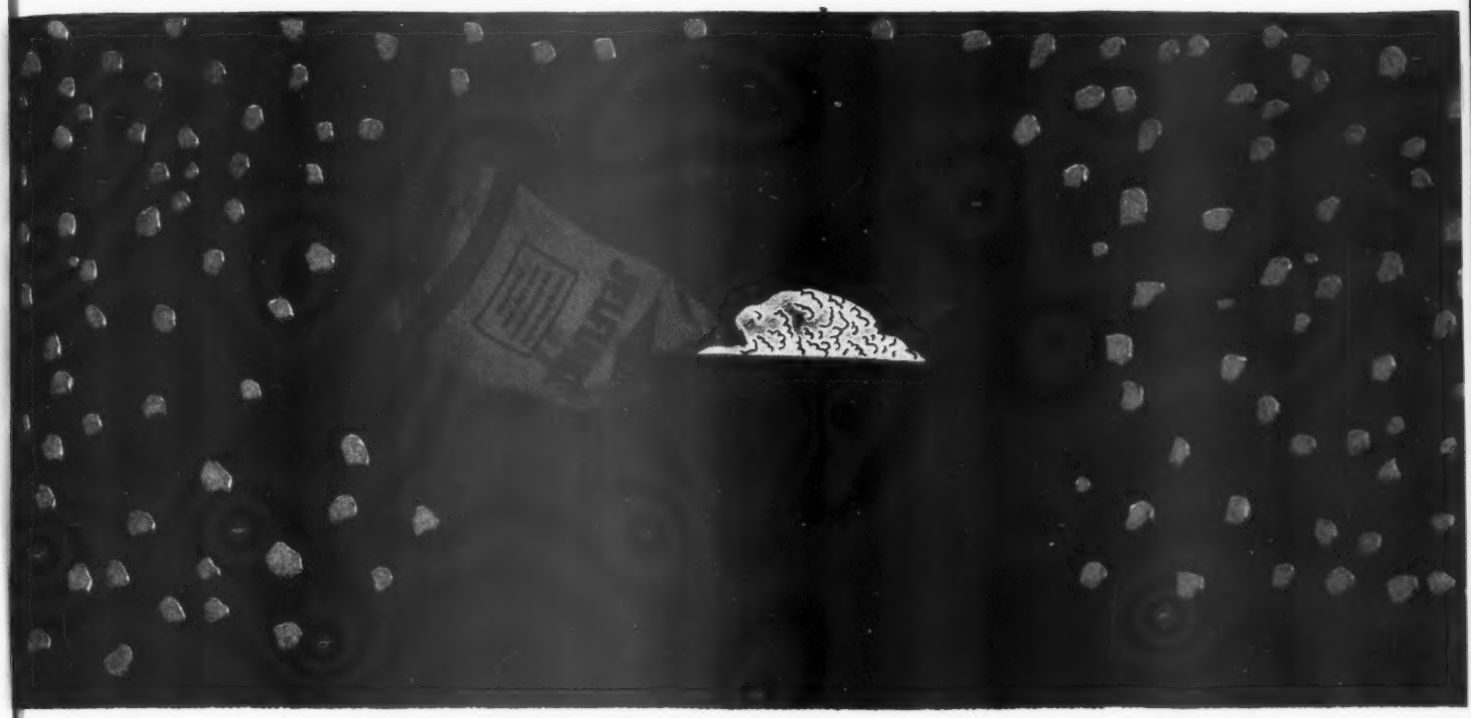

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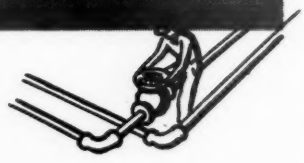
pipeline developments



● **LONG LINE TO PLANT.** The Phillips Petroleum Company recently announced through its wholly-owned subsidiary, Standish Pipe Line Company, plans for the construction of a 12-in. crude oil line 289 miles in length to transport oil from a central gathering point near the Goldsmith pool in Ector County, West Texas, to the Borger, Texas, refinery. At present the company has in excess of 35,000 bbl. of daily production in the Permian Basin area. Initial throughput is estimated at 50,000 bbl. per day and maximum capacity will be 70,000 bbl. per day.

● **WIDE EXTENSION ANNOUNCED.** Stanolind Pipe Line Company plans a program of capacity increases and extension of facilities to cover the West Texas system, it was announced by F. O. Prior, chairman of the board, and Bruce C. Clardy, president of the company. Plans will involve changes almost throughout the firm's nation-wide network.

The company will extend its 16-in. West Texas to Drumright, Oklahoma, line, now serving the Slaughter and Wasson fields, 75 miles south to connect various fields in Gaines, Andrews, Ector, and Winkler counties. Two intermediate main line stations are now being erected on this line between the Slaughter field and Drumright, which will increase delivery to the company's main trunk system from 68,000 to 85,000 bbl. per day.

Prior said as soon as pipe is available, capacity of the West Texas-Drumright system will be further increased to 126,000 bbl. by construction of 265 miles of 16-in. loops.

● **SKELLY GATHERING LINE.** A pipe line for gathering its own crude production in the Velma oil fields, east of Duncan, Oklahoma, will be built by the Skelly Oil Company in the near future. During the past, all of Skelly's production in that area has gone to the Rock Island refinery and to the Magnolia Petroleum Company. Four different sized lines, 2-in., 3-in., 4-in. and 6-in., will be put down to the various locations in the Velma area. They will connect with a larger line, which will extend to the Tussy pumping station, east across the Carter County line.

● **PLAN ADDITION.** William D. Weidlen, president of the Mid-Continent Gas Transmission Company, announced that subject to approval by the Federal Power Commission, his firm planned to construct a 26-in. industrial gas pipe line between Kansas City and the Hugoton field in Kansas and Oklahoma by next fall.

● **COMPRESSORS TO BE ADDED.** The Federal Power Commission has authorized the Panhandle Eastern Pipe Line Company to start installation of additional compressor units to meet demands for natural gas service pending a public hearing to be held later.

The company proposes an expenditure of $2,865,000 to install eight additional units totaling 12,200 hp. in compressor stations along its pipe line system extending through Texas, Kansas, Missouri, Illinois, Indiana, Ohio and Michigan.

● **TEXAS TO ILLINOIS LINE.** The early construction by Magnolia Pipe Line Company of a 20-in. pipe line from Corsicana, Texas, to Patoka, Illinois, a distance of approximately 650 miles, was announced by J. L. Latimer, president of Magnolia Petroleum Company and Magnolia Pipe Line Company.

"This new line will connect our present Texas and Oklahoma lines with those of our Midland pipe line division that extend from East St. Louis to Lima, Ohio," Latimer said, "and will provide for the delivery of crude to affiliated Socony-Vacuum Oil Company refineries at East St. Louis, Trenton, Michigan, East Chicago, and Buffalo, New York."

"The aerial survey has been completed," Mr. Latimer continued, "and the ground survey is now being made and right-of-way purchased. The new line will have a daily capacity of 100,000 bbl. of crude oil. Four stations are planned and will be equipped with electrically driven centrifugal pumps. It is expected that the delivery of pipe and pump station equipment will begin in the spring of 1947 and that the line will be ready for operation early in 1948."

● **NEW FACILITIES PLANNED.** The Hope Natural Gas Company, Clarksburg, West Virginia, has filed an application with the Federal Power Commission for authority to construct additional gas transmission facilities in West Virginia at an approximate cost of $4,600,000. The proposed facilities would bring into the company's system additional supplies of gas from production in Wyoming County, West Virginia.

The construction proposed includes installation of an aggregate of 2400 hp. compressor capacity at the Oscar Nelson station in Wyoming County, an aggregate of 1600 hp. compressor capacity at the Loup Creek station in Wyoming County, an aggregate of 2400 hp. at Jones compressor station in Gilmer County, and an aggregate of 4000 hp. compressor capacity in Hastings compressor station in Wetzel County, together with a new boiler of 125,000-lb. per hr. capacity. Loop lines proposed consist of 20-in. pipe line aggregating about 58 miles. The lines would parallel existing lines running from Jackson to Cornwell station in Kanawha County, from Minnora to Jones station in Gilmer County and from Fleming Junction in Ritchie County to Maxwell Junction in Doddridge County, all in West Virginia.

● **GAS FROM EDMOND.** Completion of a 64-mile, 12-in. natural gas pipe line from the West Edmond field to the Drumright compressor station of Cities Service Gas Company was celebrated November 1 when S. B. Irelan, president of the company, officially opened the new line.

The new line will increase the delivery capacity of Cities Service Gas to the east side of the pipe line system and the Kansas City market area to an ultimate daily volume of more than 60,000,000 cu. ft. of gas from the Edmond and West Edmond area. Phillips Petroleum and Continental Oil supply the gas from the gasoline plant in the West Edmond field. Completion of the 12-in. line will also enable Cities Service to transport an additional 20,000,000 cu. ft. daily through the existing 20-in. line north from Oklahoma City. This gas will be supplied from new townsite wells in Cement in the Caddo County field.

Cost of the new facilities connecting West Edmond and Drumright was approximately $1,000,000. Actual construction began early in August of this year.

● **BOLIVIAN LINE.** Yacimientos Petroliferos Fiscales (Bolivian Government Oil Fields) has contracted with Williams Brothers Corporation for the surveying, ditching, laying, and completion of a 225-mile 6-in. pipe line from the Camiri pool and refinery near the Chaco region of southeastern Bolivia to Tin Tin, in Cochabampa province. Williams Brothers engineers are now making a physical survey before pipe and equipment is moved into the republic. Bolivia is an inland country, and to get to the area being surveyed the Williams Brothers engineers must traverse a part of Chile, or enter from Argentina.

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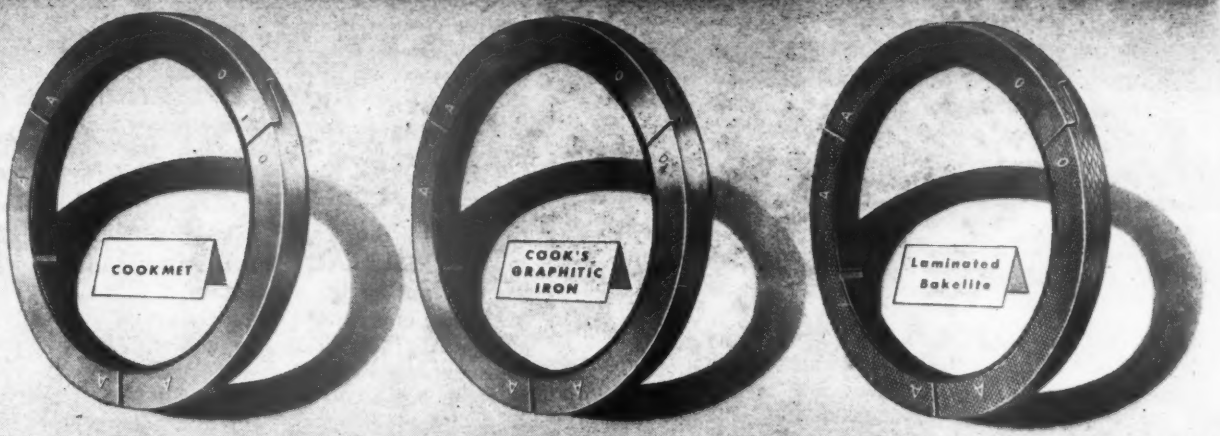

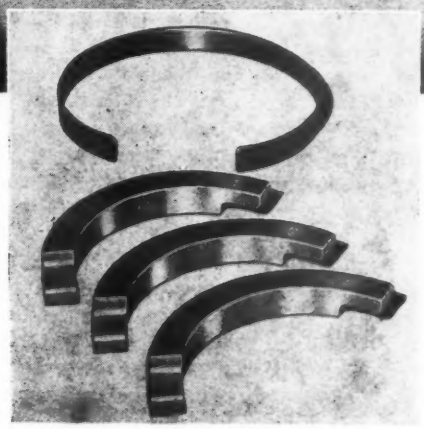

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refining and natural gasoline activities

● **REFINERY TO BE ENLARGED.** Plans for a $4,000,000 construction program to enlarge Continental Oil Company's Denver refinery to twice its present size have been announced at the company's general offices in Ponca City, Oklahoma.

The project will include erection of catalytic cracking and polymerization units of the type used during the war for the manufacture of 100-octane gasoline. Completion of the project, which is scheduled for early 1948, will boost the crude oil charging capacity of Continental's Denver refinery to approximately 7500 bbl. daily. Construction work will begin in the early spring of 1947, and about 300 men will be required in building the new units, the announcement stated. Oil processed in this plant will be from Continental's own wells in the Rocky Mountain area, mainly from the Lance Creek and Rangely fields and will flow into the Denver refinery through the lines of the Rocky Mountain Pipe Line Company, which are owned in large part by Continental. The refinery was built in 1930 and was enlarged in 1936. The new construction program will not only double the size of the plant but will completely modernize it, utilizing the very latest equipment developed during and since the war.

● **CATALYTIC CRACKER COMPLETED.** With the starting up by The Standard Oil Company (Indiana) of a new fluid catalytic cracking unit at its Whiting, Indiana, refinery, attention focused on this company's comprehensive expansion program, which will mean an increase of 75,000 bbl. per stream day in cracking capacity of the oil refinery industry in the middlewest next year.

The program includes four fluid cat-crackers, two at Whiting, one at Sugar Creek, Missouri, and one planned at the company's Casper, Wyoming, refinery. Present plans for each of the first three of these units call for the processing of 25,000 bbl. Engineering and construction is being done by The M. W. Kellogg Company, under the general supervision of the technical staff of Standard Oil Company.

● **PROPOSES PURCHASE.** Petroleum Heat and Power Company is negotiating for the purchase of two Texas refineries as part of a plan to build up an integrated oil company. The properties involved are the Taylor Refining Company, Taylor, with a refinery at Corpus Christi, and Coastal Refineries, Inc., Taylor, with a refinery at Port Isabel. Petroleum Heat is now primarily a marketing company. Last June stockholders authorized the company to borrow up to $3,000,000 for expansion.

● **SHELL TO INCREASE SYNTHETICS.** A $2,500,000 expansion program that is expected to increase Shell Chemical Corporation's capacity to produce methyl ethyl ketone and secondary butyl alcohol by 150 per cent is now well under way, J. Oostermeyer, president of the company, announced. The expansion program is said to be directed chiefly toward the installation of facilities for the production of these chemicals at the corporation's Houston, Texas, plant, and as this company is already a leading producer of these synthetic chemicals, will greatly strengthen its position in the field. Contractor for expansion of the Houston facilities is to be C. F. Braun and Company. Maximum production is scheduled to be attained by third quarter, 1947.

● **PLAN ARIZONA REFINERY.** The Arizona Petroleum Corporation, which plans a 600-mile pipe line from West Texas oil fields into Arizona's Salt River valley and a big refinery at Phoenix, has filed articles of incorporation with the state corporation commission in Phoenix.

● **ALABAMA UNIT IN OPERATION.** H. L. Hunt, Inc., has started up its new 3000-bbl.-a-day refinery at Tuscaloosa, Alabama, designed to process low grade crude oil. Hunt has erected storage nearby and had 64,000 bbl. of Gilbertown and East Gilbertown crude from the two Alabama pools and from the adjacent areas of southeastern Mississippi.

● **BRITISH PLANT.** Anglo-American Oil Company, Ltd., has announced that it has asked government approval to modernize and expand considerably the refinery operated by a subsidiary, AGWI Petroleum Corp., Ltd., at Fawley, near Southampton, England. The enlarged capacity is expected to be about 3,000,000 tons (20,000,000 bbl.) per year and the expenditure involved upwards of £10,000,000 ($40,000,000).

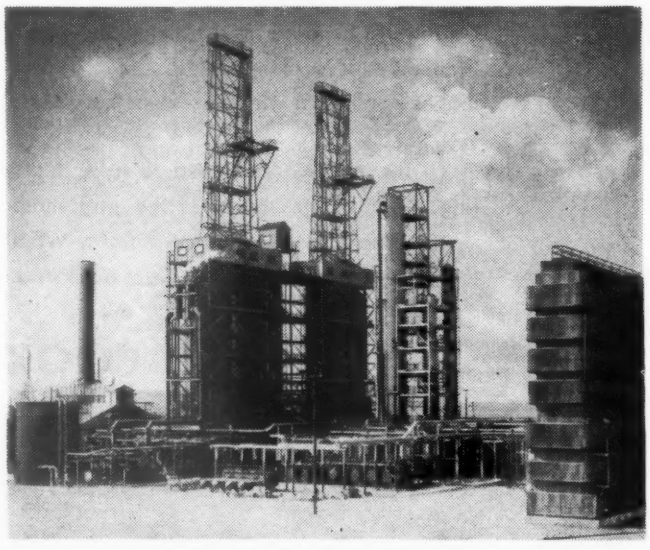
● **BIGGEST COKING UNIT.** The world's largest delayed coking unit has recently been placed in operation at the Torrance, California, refinery of General Petroleum Corporation, Pacific Coast affiliate of Socony-Vacuum. This unit, first of its kind since the end of the war, was designed and erected by the M. W. Kellogg Company, petroleum engineers of New York, to prepare gas oil from a heavy California reduced crude.

General Petroleum engineers state that operation of this service unit is resulting in overall increased yields of motor gasoline and diesel fuel per barrel of crude oil processed in the refinery, and an improvement in the octane rating of gasoline. At the same time, the overall percentage of less profitable fuel oil has been reduced since all liquid products from the delayed coker are lighter than fuel oil.

An important product of the unit's operation is a high grade petroleum coke, amounting to over 200,000 tons per year. This product is sold as a raw material for manufacture of carbon electrodes used in the aluminum and other electrometallurgical industries.

A feature of the unit is a hydraulic method of removing coke from the drums. Water jets at the high pressure of 1500 lb. per sq. in. safely and speedily slice coke from the drums and wash it to a main pit from which a specially designed pump transports the cleaned and sized coke to storage.

World's largest delayed coking unit, Torrance, California.



THE Petroleum Engineer

NOVEMBER, 1946

Research and progress in petroleum refining

By **WAYNE C. EDMISTER,** Foster Wheeler Corporation

THE short but very active and progressive history of petroleum refining demonstrates that *research* is an activity and a state of mind for the entire organization, not just for the scientists. A research attitude is essential to progress in so highly technical an industry as petroleum refining. Such an attitude results in progressive and coordinated action.

EXCLUSIVE

Petroleum refinery management periodically asks the question, "What type and how much research should we be doing?" The answer to this question depends upon the objective, which might be to find a new catalyst or a new process; to improve the yields, efficiencies or product qualities of an existing process; or to reduce operating costs and improve the competitive position of the refinery. In all of these the attitude should be that of asking and finding the answers to questions; logical, pertinent, technical, and practical questions.

What constitutes research in the petroleum industry? Research may involve: (1) Searching for a new process to make a desired synthetic hydrocarbon; (2) developing the process from test-tube to commercial proportions; (3) designing equipment to carry out the process on a refinery scale; or (4) improving the process while in operation; depending upon the particular conditions and circumstances. A type of research that may be appropriate and profitable for one company might not be so for another.

COORDINATED FUNCTIONS

Petroleum refining process research involves the cooperative efforts of the chemist, physicist, engineer, operator, superintendent, manager, and executive. Research is not limited to the laboratory but continues in the drafting-room, the plant and in development offices, the equipment manufacturers, the contractor, and the refinery.

In the broad sense of the word, *research* in the petroleum industry involves combined and correlated activities along *development*, *design*, and *operation* lines. Thinking of these three functions as related and coordinated phases of research in petroleum refining has a unifying influence on the research efforts.

Development continues on through the design and operation stages of any new process so that the next unit will be an improved model. Good design is based on both development results and operating experience and, in this respect, is the link between development and operation. During the operation of a unit many improvements and changes are found necessary. Thus development and design continue.

To a certain extent this close relationship between development, design, and operation exists in all industries but it is particularly true in the petroleum refining industry where great strides have been made in petroleum processing during recent years. A good measure of the credit for this progress should go to the spirit of cooperative research that prevails among the various organizations and departments engaged in this field.

This progressive and cooperative research paid good dividends during the recent global war, in which superior petroleum products gave the Allies a definite advantage over the enemy. The wartime accelerated activities in refining technique have greatly stimulated interest in continuing cooperation toward improving the efficiency of refining processes, the quality of petroleum products, and better utilization of our natural resources.

The announcements that have appeared in the trade journals and newspapers during recent months telling of expanded research programs at most of the oil companies, indicate a significant trend. The planned expansions in research facilities and personnel are tremendous, both as to dollars and numbers of research workers.

In contemplating these expanded research activities, it is important to bear in mind that research in petroleum re-

fining is an activity that can be carried out in all parts of the refinery as well as the laboratory; however, there must be an inquiring attitude.

RESEARCH ACTIVITIES

With *research* defined as coordinated *development, design,* and *operation* activities, it is of interest to discuss these activities and show how they are related. This can be done more significantly by reference to Fig. 1, which represents this triple-function concept of research in petroleum refining and shows the varous activities, each of which is connected to every other activity by straight lines, thus forming an interesting pattern and defining petroleum refining research. This symbolic design represents the ideal state of cooperation that should exist between these various activities for best results and most progress.

Each of the three research functions is divided into three specialized activities, making a total of nine research activities in all. These activities supplement each other and contribute to the progress of petroleum refining in the ways outlined below.

Development activities may be divided into three classifications; namely, exploration, pilot plant, and correlation. Exploration experimentation involves searching for unknown facts, or seeking basic scientific information without definite applications in mind. Pilot plant operations are concerned with the evaluation and perfection of a new process. Both exploratory and pilot plant developments are followed by the correlation and interpretation of data to make the most of the results.

Design activities likewise are divided into three classifications; namely, speculative, process, and mechanical. Design studies made for a prospective but untried process without a firm experi-

FIG. 1. CHART SHOWING NINE RESEARCH ACTIVITIES AND THEIR INTERRELATIONSHIPS.

mental basis for purposes of preliminary evaluation and/or guiding development work, constitutes speculation design activities. Process design involves establishing the operating conditions with capacities and sizes of all equipment; whereas mechanical design is concerned with materials of construction and specifications of all equipment and the erection of the plant.

Operation activities are also divided into three classifications; namely, technical service, economics, and maintenance. Technical service activities, which are usually performed by chemists or engineers, cover any type of technical problem that might arise during the operation of the unit, including: yields, efficiency, corrosion, process and mechanical improvements, utilities, charge stock, product specifications, etc. Economics activities are concerned with operating costs and realizations, which involve yields, costs of raw material, labor, liquid recovery, utilities costs, product sale prices, taxes, etc. Maintenance activities include equipment inspection and repair. All three of these operations activities contribute to refinery progress. Those engaged in technical service, economics, and maintenance activities are in the best position to recognize improvement possibilities in the plant and to initiate development studies, either in the plant, the laboratory, or in the design office.

The various aspects of this general picture of research will now be discussed in more detail.

PROCESS DEVELOPMENT

Exploratory development is just what the term implies—searching to discover new reactions, new processes, new catalysts, new solvents, new products, or new by-products. The objectives of exploratory development are usually to show the way for pilot plant and design investigations. Exploratory research will be carried out in glass apparatus if pressure and temperature conditions are not too high, in which case high-pressure experimental technique with heavy steel apparatus is employed. Exploratory experiments are usually small-scale batch operations and are often bench scale. In exploratory work there is more emphasis on qualitative than quantitative results.

Another type of small bench-scale experimentation that fits into the process development picture is the analytical work to find the properties of the hydrocarbon charge and products for development and plant operations. In addition to analyzing products by routine standardized tests, fundamental properties such as vapor pressures, densities, viscosities, critical conditions, specific and latent heats, volumetric behavior, etc., for the hydrocarbon systems are determined for use in design calculations.

Pilot plant and semi-commercial development of petroleum refining processes are usually continuous, rather than batch operatoins, and are carried out on a larger scale than exploratory experiments but on a much smaller scale than commercial operations. The objective of pilot plant experimentation is to obtain performance data required in designing new or established processing plants. In the pilot plant it is possible to try out various operating conditions and catalysts more cheaply and conveniently than would be possible on a larger scale. The following capacity ranges are typical for experimental and plant operations:

Pilot plant	0.5 to 2.0 bbl. per day
Semi-commercial	50 to 100 bbl. per day
Commercial	1000 to 20,000 bbl. per day

The proper selection of pilot plant capacity involves several considerations. The size of the apparatus and the throughput should be large enough to give sufficiently accurate yields, to have enough samples for analytical work, and also to permit maintaining uniform operating conditions. On the other hand, the size and capacity must be kept small enough to avoid handling excessively large volumes of charge and products. In order to simulate, as closely as possible, the operating conditions that will be obtained on the commercial unit, pilot plant equipment is frequently provided with electric resistance heaters to compensate for the heat losses. With heaters of this kind it is possible to maintain adiabatic or isothermal conditions, as desired, in the pilot plant reactor.

Semi-commercial scale experimentation, which must be carried out in close connection with the refinery and not in a laboratory because of the large quantities of oil involved, is employed to carry the development of a new process a stage further. This might involve testing a given improvement on the semi-commercial unit before incorporating it in a commercial design. Semi-commercial units are very seldom used to evaluate a process on a given new feed stock or to provide routine design data. A semi-commercial unit constitutes an excellent unit for demonstrating a new process.

Correlation and interpretation of data are important activities of petroleum refining development and design. By means of correlation and interpretation methods based on fundamental principles of engineering and unit operations, it is possible to project pilot-plant laboratory data from small scale as much as ten thousandfold for purposes of design. In addition it is possible to apply fundamental properties, such as vapor pressures, specific heats, heats of vaporization, etc., on petroleum hydrocarbons to the process design calculations, such as heat balances, phase equilibrium calculations, etc. In making correlations of fundamental and experimental data, dimensionless groups of variables and corresponding reference states have been found very useful.

Examples of the types of design tools that are developed by correlation methods are: (1) Effect of pressure on the enthalpy of hydrocarbon mixtures, and (2) effect of time and temperature upon conversion reactions such as cracking. The effect of pressure on the enthalpy correlation is developed from fundamental data on the volumetric behavior of hydrocarbon mixtures. The effect of time and temperature on the rates of conversion are usually obtained by correlating and interpreting pilot plant laboratory data. Both of these correlations can be set up in terms of the properties of the petroleum fractions concerned. As petroleum is a complex mixture, this requires very careful selection of the characterizing properties. For these purposes, such variables as the pseudo-critical condition, the volumetric average boiling point, the U.O.P. characterization factor, etc., have been used advantageously. Tools of this kind are also very useful in interpreting operating data. In many cases, plant operating data can be incorporated in these correlations.

PROCESS ENGINEERING

In developing a new process, it is frequently necessary to make speculative design studies before completion of the experimental work in order to find out what type of data are needed in making the firm process design calculations. Speculative studies of this kind often show the alternate possibilities for carrying out the proposed process and at the same time indicate which process schemes are impractical. In this way, the course of the pilot plant development program is guided along more productive lines. Speculative design studies will also indicate how the pilot plant unit or the semi-commercial unit should be built and operated.

After pilot plant development data have been obtained and correlated, the designer can proceed with the preparation of process calculations, which include: operating conditions, flow rates, and capacities of all equipment. These process design calculations utilize experience previously obtained on the equipment to carry out heating, cooling, pumping, controlling, and separating operations.

Process design calculations may be divided into four categories; namely, material balances, heat balances, equilibrium (phase or reaction), and rate of transfer. The material balances involve setting up the yields both on an ultimate and a once-through basis with the proper recycle included. In some cases, it is necessary to make component breakdowns for the products for use in making the heat balance and equilibrium calculations.

In making heat balances on petroleum refining operations, it is sometimes possible to compute the heat content for the hydrocarbon mixture as a whole rather than by components. Heat balances may be made on a net or a gross basis depending upon the particular problem and the type of heat charts being used. Sometimes it is more convenient to calculate a net heat balance and thus avoid the complications of establishing an arbitrary datum point. On this basis a heat balance for a fractionating tower being

charged a mixture of gasoline hydrocarbons would involve estimating the heat changes in the distillate and bottoms components from feed to product conditions and the heat added in the reboiler and removed in the condenser. None of the heat contents need to be above any particular datum as changes in the heat content may be used. For reactor heat balances it is necessary to choose a datum point because the heat of reaction and the enthalpy changes must all be referred to the same datum. The heat of reaction is quite often available at a low-temperature standard state and must be corrected to the conditions involved.

The datum point for reactor heat balances may be as near to the reaction temperature as possible. For an isothermal reaction this is easy to define but for an adiabatic reactor it may be the inlet or the outlet conditions. By means of net heat balances and variable datum points the problem of calculating the heat quantities for the lighter components of the feed or the products is simplified.

Phase equilibrium calculations to determine the temperatures and also compositions of equilibrium vapor and liquid may be made by component or empirical methods, the first being based, in part, on theoretical considerations, whereas the latter is largely based on laboratory and/or plant data. Frequently, it is necessary to make a combined phase equilibrium and heat balance calculation, which involves double trial-and-error calculations. An example of this type of calculation is a partial condenser handling a mixture of hydrocarbons.

Chemical reaction equilibrium calculations are not very often encountered in regular process design work as reaction equilibrium conditions are not approached very closely in commercial processes and because the distribution of products is usually established by pilot plant experiments. Reaction equilibrium calculations frequently are necessary in making speculative design calculations, however, and in this connection correlations of thermochemical data are very important.

The equations for the rate of transfer of heat or fluids are fundamentally the same, i.e., quantity equal resistance times driving force, all in consistent units. The resistance, i.e., friction, film coefficient, etc., for process calculations are obtained from analyzing plant data. Reaction rates present a special problem, solved by means of kinetics and experimental data.

Petroleum refining processes have many items of equipment and many operations in common—such as heaters, fractionating towers, pumps, exchangers, coolers, instruments, etc., so that experience gained on operating units is helpful in a new process. In its broadest sense, *process engineering* consists of correlating unit operating experience on a fundamental basis, followed by the application of these basic principles to the design of similar equipment for new services. To use an obvious example, a pump can be designed to pump a given quantity and quality of oil from one pressure to another, regardless of whether that pumping operation is to be a part of a thermal cracking unit, a catalytic cracking unit, or a lube oil refining plant. When applied to fractionating towers, heaters, reactors, etc., this philosophy constitutes *process engineering*. This approach contributes a great deal to the coordination of development, design, and operation.

The larger engineering-contracting firms have pilot plant laboratories for evaluating charge stocks and obtaining process design data. They also have process engineers to make or check the process design calculations and specifications. This is done in close cooperation with equipment design and selection. Operating experience obtained in starting and testing a unit is applied to this process engineering work.

Development in process engineering technique that have been made in the petroleum refining industry have many applications in chemical plant design. This is particularly true of the practice of projecting small-scale operations to plant scale.

MECHANICAL ENGINEERING

After the process design has been finished, the next step is the mechanical design and preparation of complete specifications for all the equipment. This activity involves a knowledge of the proper materials of construction and requires close collaboration with the equipment manufacturer. Having the proper alloys and adequate equipment to carry out the required processing conditions is essential to the success of a new process. Sometimes mechanical limitations or changes alter the plans enough so that revisions are necessary in the process calculations. This, plus the fact that many process check calculations are required during the course of the job, keeps the process and the mechanical engineers working closely together.

Contractor contributions in this respect are numerous. In addition to having operating engineers in the field, the large firms have specialists on pumps, instruments, exchangers, vessels, heaters, piping, etc. All this experience goes into the preparation of the job drawings and specificatoins. Equipment arrangement for most economical operation and maintenance is one of the contractor's most valuable contributions to a job.

Plant maintenance is included as a research activity because it is through the inspection, maintenance, and repair work that the operators and the engineers learn about the performance of different items of equipment and materials. Through this experience, new units can be designed more intelligently so as to benefit from the mechanical problems that have already arisen and been solved in the plant. Also this experience helps to push up the severity of operating conditions. Progress is frequently limited by the type of materials that are available. This practical solution of mechanical problems is very important because it frequently turns out that maintenance troubles are not at all the same as anticipated from theoretical considerations and analogies made before the plant was built. Accordingly, the plant experiences through the inspection, maintenance, and repair of equipment should be correlated with the development and design activities in order to improve further the existing refinery processes and make possible the perfection of new and better refining operations.

It is well known that the quality of materials of construction and equipment available is an important factor in the commercial success of modern petroleum refining processes. American engineers are often reminded of this fact in talking to foreign engineers, who state that they buy American equipment because it is superior to what they have.

Refining companies follow the performance of plants to obtain information on equipment as well as process operations. Large engineering and contracting firms likewise keep in touch with plants they have built to confirm and/or revise their information about equipment performance.

Almost all refinery engineering and construction, and some maintenance work, are contracted to engineering and construction firms. In this way, the refining organization is able to devote its time and energies to refining. It hasn't always been this way. In the early days, when refineries were continually expanding and when construction was simpler, a large part of the refinery construction was handled by the oil company. Shell stills and Burton stills were erected by the battery rather than by the unit, making a great deal of duplication.

As the character of refinery construction changed, it became more satisfactory to have contracting firms handle the expansion jobs. Very few refineries can justify a construction department with crews and tools required for occasional large erection jobs. In addition to the payroll burden between jobs, there are the labor union situation, seniority rights and salary scales among the regular refinery employes, safety regulations, and erection experience to justify contracting this work.

TECHNICAL SERVICE

After an oil refining unit is built and ready to operate, the problems and activities that contribute to progress are those of operation, which have been divided into three categories; namely, technical service, economics, and maintenance. In the sense of improving operating efficiency and economy, considerable research work is carried out in the plant. Although most changes are first tried out on the pilot plant or semicommerical plant scale and the effect of these changes checked by process calculations before they are incoporated in the commercial unit, many of the ideas for improvement originate in the plant

and are finally proved on the commercial units.

Technical service involves following the performance of the commercial unit, making periodic efficiency and yield tests and comparing the results with those expected from the pilot plant data. In this respect, the *technical service* is a liaison function relating development, design, and operation. Technical service activities are normally carried on by trained chemists and engineers who understand the theoretical as well as the practical aspects of the processes they are following. All oil companies engaged in large-scale research also have effective technical service divisions because it is well recognized that technical service is essential to the profitable operation of modern petroleum refineries. In smaller companies technical service may constitute practically all the research work and may be carried out by engineers assigned to the operating or managerial departments.

For a small company, technical service may be the only type of research that can be justified. It is important that small refining companies, falling in this category, maintain a spirit of research throughout their organization even though their research department may only consist of one man and their research activities may be limited to following the development of others from reports and technical literature and interpreting this technical progress to the management and making recommendations. Just because a company is not large enough to have a full-size research and development department is no reason for it to give up and be content with doing things in the same way that they have been done in the past.

REFINERY ECONOMICS

From the initial operating period on, development and progress are more concerned with operation costs and profits than with new discoveries, but this is research also. By this time, the economic calculations made to see whether the new unit can be justified are only of academic interest because the unit is built and the problem is to operate the unit as profitably as possible. This involves the proper choice of charge stock, operating conditions, catalyst, materials for repair, and also good maintenance. Catalytic cracking is an interesting example of this point.

Many refiners have catalytic cracking units that were built during the war primarily for aviation gasoline manufacture. These units are now being operated for motor gasoline manufacture, which requires different operating conditions. A refiner having ample thermal cracking capacity may find it desirable to run his catalytic cracking units at a lower conversion level and thereby obtain much higher capacity, sending the cycle stock to the thermal cracking units for further cracking. Another refiner, differently situated so far as thermal cracking capacity is concerned, may find it preferable to operate his catalytic cracking unit at a higher conversion level, even to the point of recycling and selling his excess cycle gas oil, and doing no thermal cracking. These are all questions of economics and must be developed for each individual case, depending upon the process, the type of crude oil, the markets, the price of fuel oil and, of course, the existing refinery picture.

This same philosophy of operation research applies in a lesser degree to the older processes, such as thermal cracking, thermal reforming, and catalytic polymerization, etc. As regards thermal reforming and catalytic polymerization, an important consideration is the price of tetraethyl lead, fuel value, straight-run octane number, and the market for liquefied petroleum gases. In some cases, it might not be wise to build new catalytic processes, particularly in small refineries situated in advantageous positions as regards crude and markets. In other cases, it might be unwise to do any thermal reforming or cracking. Specialty products, such as solvent naphthas, waxes, greases, asphalts, etc., oftentimes constitute important considerations in planning refinery operations.

In making an evaluation study for any given refinery situation, it is always necessary to consider the particular situation concerned because the unit cost figures usually vary sufficiently to make "standard" or "typical" economic studies invalid. It is also necessary to consider the performance of the various existing facilities in such a study. This all comes under the heading of "operation know-how." One of the most important considerations in such evaluation studies is the total liquid recovery. Economic studies are often invalidated by discrepancies or inconsistencies in the ultimate yields. This is particularly true when comparing two possible cases of operation that are relatively close, a slight gain in one case or a slight loss in the other case might make the comparison lead to the wrong conclusions. Because of this, it is necessary to make the material balances very carefully, using accurate yields, tank gaugings, and calculating machines, and carrying the colculations out to several significant figures.

Another source of error in making economic calculations is the quantities of gas and coke made. This is particularly true on cracking operations where the gas produced usually has only fuel value and the coke may be deposited on the catalyst to be burned off.

Economic studies made concurrently with operations to determine whether or not proposed changes in the operations would show better economics, are progressive activities. This type of work is not to be confused with the routine operating accounting that is a necessary function of all operating departments. The economics work is normally carried out by technically trained chemists and engineers in close collaboration with the operating supervisors and the management, and also the designing engineers.

Proposed changes in equipment and/or operating technique or products to be produced must first be studied by the economics group before plans are completed for the proposed revisions. This type of economics work requires an accurate knowledge of operating costs and yields for the existing refinery operations. This cost information must be broken down to reflect the costs of labor, maintenance, fuel, raw materials, overhead, etc., and should be expressed on an incremental basis so as to permit evaluating the operating costs at various capacities. With incremental costs, it is possible to make comparisons between two alternate operations and show the difference in profits, pay-out periods, etc.

PROGRESS IN PROCESSING

During the past decade, a great deal has appeared in technical and trade literature about new process developments in the field of petroleum refining. There have been polymerization, hydrogeneration, alkylation, catalytic cracking, hydroforming, isomerization, etc. These developments have been the result of research by large organizatons with the laboratory, engineering, and operating departments participating. Each process is covered by many patents. In their commercial form none of these processes represents the result of a "flash of genius" by a single inventor. In many cases, the developments have resulted from systematic and thorough searches covering catalysts and conditions selected to blanket all possibilities. In some cases, the results have come unexpectedly while searching for something else.

In petroleum refining, a single technician cannot sit down on any given date and invent a process at will. Inventing is the result of inspiration, which usually follows long, hard work. Small organizations with limited resources must be realistic about this situation and devote their research time to making improvements that will increase their refining efficiency, decrease their operating and maintenance costs and thereby increase their profits.

Any refiner can have any of these new catalytic processes by paying the price of the licenses and the engineering and construction of the plant. Along with these licenses and engineering construction services, the refiner gets a certain amount of know-how that has been accumulated on several previous jobs. Even where the process is a new one and the unit to be built is the only one of its kind, the licensing agent and the engineer-contractor still have considerable know-how to contribute to the project because of experience accumulated in building other units.

Process developments in petroleum refining during recent years have been so varied that flowsheet illustrations for the entire field would be complex and voluminous. These process developments are described in the selected references given at the end of this article. In addition to covering each process, some of these references deal with the applica-

tions of the processes to given refinery situations. It is not possible to obtain from the literature sufficient information to permit making a very reliable evaluation and selection of a process for a given refinery situation. The proper selection and integration of petroleum refining processes must be worked out for the particular situation by the cooperative efforts of the licensor, refiner, and engineering contractor.

For many years thermal cracking was the outstanding example of progress in petroleum refining. Catalytic cracking is the current example of refining progress. Thermal cracking practice developed from batch shell-still operations during World War I to the large combination cracking, reforming, and crude running units built in the 1930's. Catalytic cracking went from experimental to commercial operations very rapidly, partly because of World War II and the need for aviation gasoline, partly because of competition, and partly because of increased technical skill. The fluid catalyst technique appears to have many more applications than catalytic cracking, where it was perfected. Fundamental developments of this kind are landmarks in the history of any industry.

Other processes, such as alkylation, polymerization, isomerization, and hydroforming, for remaking the hydrocarbon molecules, also contribute to petroleum refining progress. In general, it is difficult to justify hydrocarbon remodeling operations unless a waste or low-value product is converted to a high-value product. Polymer gasoline from refinery gases is easier to justify than hydroforming of naphtha, for example. Where thermal reforming is required to raise the gasoline octane number, polymerization is practically a necessity because of the high losses that would otherwise result.

The triple function conception of research in petroleum refining is illustrated by the history of thermal cracking. The thermal decomposition of higher-boiling petroleum fractions to produce lower-boiling volatile fractions had been demonstrated in the laboratory on a small scale many years before thermal cracking became a commercial refinery process in 1913.

For the next 30 years, process and mechanical improvements were made in the design and operating techniques of thermal cracking. Although these improvements originated at different points (in the laboratory, the drafting room, the plant control room, or the supervisory offices), most of them were perfected by cooperative efforts of *development*, *design*, and *operation* staffs.

With pilot plant apparatus, the effects of process variable changes were tried out on a small scale before taking a change in the plant. By means of experience and such correlating tools as soaking factor, the pilot plant experience was translated to a commercial scale for design and operating purposes.

When a new unit is to be built to carry out a well-established process, such as thermal cracking, the charge stock is run on a pilot-plant unit to obtain data for design purposes. In this case, the pilot plant is used to evaluate the charge and to provide design data but not necessarily to explore new operating conditions. Nevertheless, it is research because the tests are run to "find out" how the new charge will crack.

The production of olefinic hydrocarbons by pyrolysis requires higher temperatures, lower pressures, and shorter soaking times than thermal cracking to make gasoline. By means of process engineering methods, such as pilot plant runs, data analysis, and correlation, followed by unit operation process design calculations, it is possible to design and build a commercial plant of this type without going through the semi-commercial proving period. This is an extremely important precess design technique.

If pilot plant evaluations of this kind are necessary for thermal cracking, it is easy to understand why they are even more important in catalytic cracking where catalyst activity and life are additional considerations.

REFINERY UTILITIES

Refinery utilities influence refinery operating economics. Utility services not only may be inefficient and therefore add to the operating costs, but they may be unreliable and deduct from the refinery processing time through forced shutdowns, an even greater loss. Many refiners are prone to overlook the importance of their utilities services and tolerate unreasonable costs and outages of steam, water, and power services rather than making as much effort toward improving this phase of refinery operations as they do of the oil-processing phase. Inefficient utilities are in evidence at many refineries by steam being blown to the atmosphere, by excess gases being burned in the torch, by boiler and condenser scaling, and by excessive oil in the sewer effluent.

In order to avoid these losses a thorough study of the refinery utilities system should be made with a view toward balancing the power and heat loads in the different areas so as to avoid blowing exhaust steam to the atmosphere or throttling high pressure steam to make more exhaust steam. Such a balance will naturally consider steam, electric, and gas engine power alternates and also direct-fired heaters.

Improving a bad heat-power picture can often be accomplished by dual (steam and electric) drives or condensing turbines on large pumps, by a topping turbine, by a low pressure stage condensing turbo-generator, or by higher temperature boiler feedwater heating.

Cooling water systems are a common source of trouble in refineries. In some cases, chemicals are desirable to control algae, scale, and corrosion. However, the requirements of these chemicals can be kept at a minimum by properly designing and operating the cooling water system. With a trouble-free system, the maintenance on coolers and condensers is lower and, in addition, the operation of the process units is not hampered by lack of adequate condensing and cooling capacity.

As regards oil losses in the sewer effluent, the installation of a separator to recover the oil from the water before it leaves the refinery is a step in the right direction, but is not always the proper solution. In many cases, it is possible to stop these leaks and losses of oil at the source and thereby reduce the cost of separator operation and of reprocessing the slop oil collected at the separator.

REFINERY PLANNING

With the crude supply and petroleum product requirements situations as they are, refiners should give careful consideration to any plans that would involve additional processing of stocks for which there is already a ready market. Likewise, every effort should be made to find outlets for by-products. The market for fuel and diesel oils should be given serious study in the evaluation of cracking.

Developments in hydrocarbin separation technique are destined to have an important effect on the future of petroleum refining. Solvent extraction, extractive distillation, hypersorption, and azeotropic distillation are coming into more extensive application in the modern refinery.

Another development that is certain to have an influence on petroleum refining is the use of petroleum as a source of raw material for chemicals manufacture. Three such operations that reached important capacities during the recent war are the manufacture of synthetic rubber from petroleum butadiene, of aromatics from petroleum naphthas, and ammonia from natural gas. Olefin raw materials are becoming of increasing importance as starting components for chemical synthesis. There are numerous examples of expansions and new plants in the field. Most small refiners will find it better economics to limit their activities in this field to the supply of intermediates rather than making the finished chemical products.

The future octane number requirements for gasoline are of course a very important factor in planning petroleum operations. Considerable speculation has taken place on this subject and it is generally agreed that the octane numbers are going to rise mostly because of competition. From the overall economics standpoint, it may be preferable for small refineries to operate on a component rather than a finished-product basis for some of their production. This type of operation was followed during the war in making aviation gasoline because very few refineries produced all of the components of a finished aviation gasoline so that blending of stocks from different refineries was necessary.

Technical data and economic calculations can lead to profitable decisions if properly interpreted. Without sound, foresighted judgment, information of this kind has little value to the refiner and research efforts are wasted. It is well-

known that an accurate analysis without a decision and action is not worth much. Courage to act and take calculated risks is required. The winning combination is research, judgment, and then action.

Thinking of *research* in the broad aspects outlined above has a coordinating and unifying effect on *development, design*, and *operation*. With this attitude, the refinery will have periodic appraisals made of operations, particularly when considering expansion or modernization.

PATENTS AND PUBLICATIONS

An interesting corollary on the subject of "Research and Progress in Petroleum Refining" is the changing attitude about secrecy down through the years. Refiners soon learned that it was not practical nor worthwhile to attempt to keep all their operations secret. The patenting practice developed as a protection measure for the refiner's own operations as much as the basis for a licensing business. During the recent war period, refining cooperation by the various industry, government, and military committees accelerated the tempo of progress appreciably. Refiners themselves exchanged operating experience voluntarily and thus contributed to the progress that was made.

Technical publications have been another contributing factor in petroleum refining progress. There has been a marked upward trend in the volume of technical articles dealing with petroleum processing during recent years. This has been due to a changing attitude about the value of such papers. By contributing to the technical and trade literature, a refiner is participating in an exchange through which he stands to get back more than he puts out. Also the literature appearance of his paper establishes his contribution. Many refiners are eager to do this because it adds to their scientific reputation and good will with the public.

Literature research definitely has its place. The following list of references covers some of the refining articles that have appeared during recent years. These articles make very interesting reading. Taken altogether, they represent the technical pattern of the petroleum refining industry during the past decade.

LIST OF REFERENCES

1. Anderson, N. K., and M. J. Sterba—"Small-Scale Fluid-Type Catalytic Unit Designed." *Petroleum Refiner*, Vol. 24, December, 1945, p. 109.

2. Anonymous—"Neoprene." *Chem. & Met. Eng'g*, January, 1944, p. 130.

3. Anonymous—"Small Fluid Cat Cracker Designed to Compete with Units of Larger Capacity." *The Oil & Gas Journal*, June 8, 1946, p. 97.

4. Anonymous—"Styrene by Dow Process." *Chem. & Met. Eng'g*, February, 1944, p. 160.

5. Anonymous—"Aviation Gasoline." *Chem. & Met. Eng'g*, December, 1943, p. 130.

6. Anonymous—"Petroleum By-Products a Big Factor in Organic Chemical Industry." *Chem. & Met. Eng'g*, December, 1945, p. 121.

7. Anonymous—"The Fluid Catalytic Cracking Process Diagrammatically Shown Step-by-Step." *Petroleum Refiner*, May, 1945, p. 128.

8. Anonymous—"The California Synthetic Rubber Project." *Rubber Age*, May, 1944, p. 153.

9. Anonymous—"Port Neches Butadiene Plant Now on Stream." *Petroleum Refiner*, Vol. 23, No. 3, March, 1944, p. 83.

10. Anonymous—"Butyl Rubber Production at Baton Rouge." *Chem. & Met. Eng'g* July, 1943, pp. 132-135.

11. Anonymous—"Shell Isomerization Process for the Production of Isobutane." Foster Wheeler Corporation, *Bulletin 0-41-13*.

12. Anonymous—"Technological Trends Modified by War Conditions." *World Petroleum*, Annual Refinery Issue, 1940, p. 43.

13. Anonymous—"World's First Commercial Neo-Hexane Produced in Phillips Plant." *World Petroleum*, Annual Refinery Issue, 1940, p. 48.

14. Anonymous—"Rubber—From Petroleum Chart." *National Petroleum News*, June 10, 1942, p. R-190.

15. Anonymous—"World's Refining Facilities Respond to War's Influences." *World Petroleum*, Annual Refinery Issue, 1939, p. 86.

16. Anonymous—"Cold Acid Treatment of Cracked Distillate." *World Petroleum*, Annual Refinery Issue, 1939, p. 76.

17. Anonymous—"Catalysis in Petroleum Refining." *World Petroleum*, Annual Refinery Issue, 1939, p. 67.

18. Anonymous—"Blueprint of Refinery Processes." *The Oil and Gas Journal*, March 31, 1945, pp. 170-216.

19. Anonymous—"Design and Operating Features of the Smallest Fluid Catalyst Cracking Unit." *The Petroleum Engineer*, May, 1945, pp. 135-140.

20. Anonymous—"8250 B/D Canadian Refinery Is Complete—Even to Modern Lube Oil Manufacture." *National Petroleum News*, Vol. 37, June 6, 1945, pp. R-417.

21. Anonymous—"Alkylation for High Octane Aviation Gasoline." Foster Wheeler Corporation, *Bulletin 0-41-11* (1941).

22. Armistead, George, Jr.—"Modern Refining Processes." *The Oil and Gas Journal*, 1946—March 2, 9, 16, 23; April 6, 13, 20; 27; May 4; July 13, 27; August 10, 31; September 23.

23. Arnold, Philip M.—"Olefin Production by Thermal Cracking of Isobutane." *The Oil and Gas Journal*, July 7, 1945, p. 37.

24. Barnard, D. P., and Forrester, J. H.—"How Will the New Processes Affect the Post-war Light-Ends Situation?" *Petroleum Refiner*, Vol. 23, No. 5, May 1944, p. 89.

25. Berg, Clyde—"Hypersorption Process for Light Gases." *A. I. Ch. E. Transactions*, Vol. 42, 1946, p. 665.

26. Birch, S. F., Dunstan, A. E., Fidler, F. A., Pirn, F. B., and Tait, T.—"Condensation of Olefins with Iso-Paraffins in Sulphuric Acid." *The Oil and Gas Journal*, June 23, 1938, p. 49.

27. Bludworth, J. E.—"Chemicals from Lighter Hydrocarbons." *Petroleum Refiner*, Vol. 25, No. 5, May, 1946, p. 102.

28. Boyd, J. H., Jr.—"Petroleum—Source of Raw Materials for Chemical Industry." *Chem. & Eng'g News*, Vol. 23, No. 4, February 25, 1945, p. 345.

29. Bogk, J. E., Ostergaard, P., and Smoley, E. R.—"Naphtha Polyform—Gas Reversion Processes Yield High Octane and Important War-Time Aromatics." *World Petroleum*, Annual Refinery Issue, 1940, p. 56.

30. Brothman, A., and Weber, A. P.—"Batch-Continuous Process for Buna S." *Chem. & Met. Eng'g*, March, 1943 p. 108.

31. Brown, Bruce K., and Barnard, D. P.—"How Will the 100 Octane Aviation Gasoline Program Affect Post-War Motor Gasoline?" *Petroleum Refiner*, Vol. 22, No. 12, December, 1943, p. 83.

32. Brown, C. L., and Gohr, E. J.—"Producing Aviation Fuels by Pressure Hydrogenation." *World Petroleum*, Annual Refinery Issue, 1937, p. 49.

33. Buell, A. E., and Skinner Bradley—"Catalytic Cracking of Texas Panhandle Gas Oil by Cycloversion Process." *The Oil and Gas Journal*, May 5, 1945, pp. 87-89.

34. Cauley, S. P., and E. B. Delgass—"Carbon-Hydrogen Ratio of Catalytically Cracked Distillate Fuel Oils." *The Oil and Gas Journal*, July 27, 1946, p. 166.

35. Cheney, H. A., and C. L. Raymond—"The Shell Vapor-Phase Isomerization Process for the Production of Isotubane." *A. I. Ch. E. Transactions* Vol. 42, 1946, p. 595.

36. Chillas, R. B. and Weir, H. M.—"Design of Fractionating Columns with Particular Reference to Petroleum Distillation." *Ind. & Eng. Chem.*, Vol. 22, 1930, p. 206.

37. Cooke, M. B.—"Demand for Aviation Fuel Coincides with Era of Catalytic Cracking." *World Petroleum*, Annual Refinery Issue, 1939, p. 72.

38. Coulthurst, L. J.—"Shell Isomerization Process for the Production of Isobutane." *The Petroleum Engineer*, January, 1942, p. 113.

39. Crossland, S. T.,—"Report on the Rubber Program 1940-1945." Rubber Reserve Company, February 24, 1945.

40. Crowe, J. M.—"Buna S. Plant Operating at Institute." *Chemical Industries*, June 1943, p. 742.

41. de Florez, Luis—"A New Type of Cracking Unit." *A.P.I. Proceedings*, Vol. XI, No. 1, Section III, January 2, 1930, p. 60.

42. Diwoky, R. J.—"Continuous Coking of Residuum by the Delayed Coking Process." Nineteenth Annual Meeting, American Petroleum Institute, Chicago Illinois, November 18, 1938.

43. Dalton, S. D., and Cauley, S. P.—"Production of Distillate Fuel Oils by Thermofor and Houdry Catalytic Cracking," *The Oil and Gas Journal*, February 10, 1945, pp. 80-87.

44. Dean, John C.—"Processing Materials from Petroleum." *Chem. & Eng. News*, Vol. 23, July 10, 1945, p. 1164.

45. Egloff, G., Thomas, C. L., and Linn, C. B.—"Pyrolysis of Propane and Butanes." *Ind. & Eng. Chem.*, Vol. 28, 1936, p. 1283.

46. Evering B. L., Fraken, N., and Weems, G. S.—"Commercial Isomerization of Light Paraffins." *Chem. & Eng'g News*, Vol. 22, November 10, 1944; *Petroleum Refiner*, Vol. 23, No. 11, November, 1944, p. 99; *National Petroleum News*, Vol. 36, No. 44, p. R-737, November 1, 1944; *Oil and Gas Journal* October 28, 1944, p. 77.

47. Egloff, Gustav, and Hulla, George—"Methods of Preparing Butadiene." *The Oil and Gas Journal*, November 5 to December 24, 1942.

48. Ebner, E. E., and Mertens, F. T.—"Lubricating Oil Plant Incorporates New Features." *World Petroleum*, Annual Refinery Issue 1944.

49. Field, Hugh W.—"Petroleum-ization—1940." Twentieth Annual Meeting of American Petroleum Institute, Chicago, Illinois, November, 1939.

50. Fischer, H. G. M. and Welty, A. B., Jr.—"Synthetic Toluol from Petroleum by Hydroforming Process." *Chem & Met. Eng.*, August, 1944, p. 92.

51. Fischer, Franz—"Synthesis of Gasoline from Carbon Monoxide and Hydrogen at Atmospheric Pressure." *Petroleum Refiner*, Vol. 23, No. 2, February, 1944, p. 112.

52. Fischer F. and Koch, H.—"The Synthesis of Lubricants from the Fischer-Tropsch Process." *Petroleum Refiner*, Vol. 23, No. 7, July, 1944, p. 106.

53. Fischer F., Koch, H., and Wiedeking, K.—"Recent Advances in Manufacture of Synthetic Lubricants from Kogasin." *Petroleum Refiner*, Vol. 23, No. 8, August, 1944, p. 116.

54. Fischer, F., Roden, Otto, and Feist, W.—"The Synthesis of Gasoline by the Fischer-Tropsch Process. *Petroleum Refiner*, Vol. 22, No. 12, p. 97.

55. Foster, Arch L.—"Petrochemistry Directs Natural-Gas Conversion at Lion Oil Company Plant." *The Oil and Gas Journal*, June 22, 1946, p. 98.

56. Foster, Arch L.—"Lubrite Converts Fuel Oil Into More Profitable Products." *National Petroleum News*, May 6, 1936.

57. Frolick, P. K. and Wiezevich—"Chemical Utilization of Natural and Refinery Gases." *Ind. & Eng. Chem.*, Vol. 24, 1932, p. 13.

58. Fuqua, F. Duane—"Crude Desalting in Refinery Operations." *National Petroleum News*, May 1, 1946, p. R-363.

59. Gard, E. W., Blount, A. L., and Korpi, K.—"Alkylation and Its Influence on the Unitization of Natural Gasoline." *The Oil and Gas Journal*. Part 1, December 14, 1939, p. 42; Part 2, December 21, 1939, p. 46.

60. Goggin, W. C.—"Styrene, Buna Rubber and Polystyrene." *Petroleum Refiner*, Vol. 23, No. 3, March, 1944, p. 87.

61. Haddeland, G. E.—"Canadian Buna-S." *Canadian Chemistry and Process Industries*, February, 1944, p. 89.

62. Happle, J., Cornell, P. W., Eastman, DuB, Fowle, M. J., Porter, C. A., Schutte, A. H.—"Extractive Distillation—Separation of C_4 Hydrocarbons Using Furfural." *A.I.Ch.E. Transactions*, 1946, Vol. 42, p. 189.

63. Hartley, F. L.—"Commercial Synthesis of Toluene by Hydroforming, and Recovery by Azeotropic Distillation." *Petroleum Refiner*, Vol. 24, December, 1945, p. 131.

64. Harrington, P. J., B. L. Bragg III, and C. O. Rhys, Jr.—"No Peace for Fractionators." *Petroleum Refiner*, Vol. 24, No. 12, December, 1945, p. 114.

65. Heath, R. W., J. B. Taylor, Jr., and P. W. Hill—"Practical Refrigeration for Natural Gasoline Plants." *The Petroleum Engineer*, May, 1946, p. 162.

66. Heinemann, Heinz—"Foreign Processes for the Conversion of Methane to Hydrogen and Carbon Monoxide." *Petroleum Refiner*, Vol. 23, No. 1, January, 1944, p. 117.

67. Hill, Al—"California Government Synthetic Rubber Plants." *India Rubber World*, Vol. 110, 1944, p. 304.

68. Hill, L. R. and J. W. Moorman—"Turnarounds in Fluid Catalytic Cracking Units." *The Petroleum Engineer*, February, 1946, p. 98.

69. Hill, L. R., G. A. Vincent, and E. F. Everett—"Hydroforming for Production of High Octane Motor Fuel." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 611.

70. Ipatieff, V. N., Corson, B. B. and Egloff, G.—"Polymerization, A New Source of Gasoline." *Ind. & Eng. Chem.*, Vol. 27, 1935, p. 1077.

71. Keith, P. C.—"Gasoline from Natural Gas." *The Oil and Gas Journal*, June 15, 1946, p. 104.

72. Komarewsky, V. I. and Riesz, C. H.—"Fischer-Tropsch Synthesis and the Petroleum Industry." *National Petroleum News*, February 7, 1945, pp. R-97-104.

73. Komarewsky V. I.—"Production of Synthetic Liquid Fuel from Natural Gas." *Petroleum Refiner*, Vol. 24, No. 5, May, 1945, p. 96.

74. Kopetz, G. E.—"Process Design for the Synthetic Rubber Plants," *National Petroleum News*, June 7, 1944.

75. Kunkel, J. H.—"Engineering Aspects of the New Utah Oil Refining Company 100 Octane Plant." *The Petroleum Engineer*, January, 1945, pp. 59-73, and February, 1945, pp. 74-98.

76. La Croix, H. N.—"Improving Lead Susceptibility of Gasoline by Refining with the Shell Solutizer Process." New York City Meeting of American Society of Mechanical Engineers, Petroleum Division, Januray 16, 1941.

77. Lake, George R.—"Recovery of Toluene from Petroleum." *A.I.Ch.E. Transactions*, Vol. 41, 1945, p. 327.

78. Lane, John C., and Weil, B. H.—"The Synthine Process." *Petroleum Refiner*, Vol. 25, No. 8, August, 1946, p. 87; Vol. 25, No. 9, September, 1946, p. 97.

79. Lassiat, R. C. and Parker, F. D.—"Butane Dehydrogenation by the Houdry Process." *Petroleum Refiner*, Vol. 23, No. 11, November, 1944, p. 85.

80. Lee, James A.—"Butyl Rubber Production Unique American Development." *Chem. & Met. Eng.*, July, 1943, p. 102.

81. Lee, James A.—"Fluid Catalysts Make Their Debut in Chemical Production." *Chem. & Met. Eng.*, July, 1945, p. 100.

82. Legatski, T. W. and Legatski, H. R.—"Desulfurization and Superfractionation Make Products of Higher Octane Number." *The Oil and Gas Journal*, May 11, 1946, p. 99.

83. Mateer, G. L., and Haney, J. D.—"Three Fluid Catalytic Cracking Units Form the Heart of New Refinery." *Oil and Gas Journal*, July 8, 1944.

84. McAllister, S. H., Ross, W. E., Randlett, H. E., and Carlson, G. J.—"The Liquid Phase Isomerization of Normal Paraffins Using a Fluid Salt Catalyst." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 33.

81. Mertens, F. T.—"Furfural Refining of Pennsylvania Oils for Severe Conditions." *World Petroleum*, Annual Refinery Issue, 1940, p. 68.

86. Miller, Benjamin — "Chemical Utilization of Natural Gas." *National Petroleum News*, Vol. 37, June 6, 1945, p. R-430; and *Petroleum Refiner*, Vol. 24, No. 5, May, 1945, p. 121.

87. Mitchell, J. Ernest, Jr.—"The Dow Process for Styrene Production." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 293.

88. Moore, W. G. and Elder, T. G.—"Effect of Catalytic Cracking on the Postwar Supply of Motor Gasolines and Distillate and Residual Fuels." February, 1944, New York Meeting of American Institute of Mining and Metallurgical Engineers, *Technical Publication No. 1731, Petroleum Technology*, July, 1944.

89. Morrell, C. E., Paltz, W. J., Packie, J. W., and Asbury, W. C.—"Purification of Butadiene with Cuprous Salt Solutions." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 473.

90. Morrell, J. C.—"Developments in Hydrocarbon Chemistry and Technology." *The Oil and Gas Journal*, March 16, 1939.

91. Murphree, E. V., Brown, C. L., Gohr, E. J., Johnig, C. E., Martin, H. Z., and Tyson, C. W.—"Improved Fluid Process for Catalytic Cracking." *A.I.Ch.E. Transactions*, Vol. 41, February 25, 1945, pp. 19-33.

92. Murphree, E. V. and Barr, F. T.—"Catalytic Hydrogenation Provides Low Cost Aviation Gasoline." *World Petroleum*, Annual Refinery Issue, 1940, p. 37.

93. Murphree, E. V., Brown, C. L., Fischer, H. G. M., Gohr, E. J., and Sweeney, W. J.—"Fluid Catalyst Process." *Ind. & Eng. Chem.*, Vol. 35, July, 1943, pp. 768-773.

94. Murphree, E. V., Fischer, H. G. M., Gohr, E. J., Sweeney, W. J. and Brown, C. L.—"Fluid Catalyst Cracking for Premium Fuels." *Petroleum Refiner*, November, 1943, pp. 87-94.

95. Murphree, E. V.—"War Developments in the Petroleum Industry." *Ind. & Eng. Chem.*, Vol. 35, June, 1943, p. 623.

96. Murphree, E. V., Gohr, E. J., Martin, H. Z., Ogorzaly, H. J., and Tyson, C. W.—"High-Capacity Operations on Fluid Cracking Units." Twenty-fifth Annual Meeting of American Petroleum Institute, Chicago, Illinois, November 15, 1945. *Petroleum Refiner*, November, 1945, p. 97.

97. Newton, R. H., and Shimp, H. G.—"The Design and Operating Features of Houdry Fixed Bed Catalytic Cracking Units. *A.I.Ch.E. Transactions*, Vol. 41, 1945, p. 197.

98. Noll, H. D., Bergstrom, E. V., and Holdom, K. G.—"Simplicity and Flexibility of Thermofor Catalytic Cracking." *The Petroleum Engineer*, Reference Annual, 1946, p. 221.

99. Noll, H. D., and Holdom, K. G.—"Small-Scale Catalytic Cracking." *Petroleum World*, February, 1946. p. 57.

100. Noll, H. D., Bergstrom, E. V., and Holdom, K. G.—"New Integral T.C.C. Unit Makes Catalytic Cracking Available to Small Refiners." *The Oil and Gas Journal*, April 6, 1946, p. 110.

101. Oberfell, G. G., and Frey, F. E.—"Thermal Alkylation and Neo-hexane." *Refiner and Natural Gasoline Manufacturer*, Vol. 18, No. 11, November, 1939, p. 108.

102. O'Donnell, J. P.—"Two Shell Developed Processes Aid in the Production of Toluene." *The Oil and Gas Journal*, December 16, 1943, p. 43.

103. Osterstrom, R. C., and Wagner, C. R.—"Principles of Vapor Phase Cracking." *A.P.I. Proceedings*, Vol. XI, No. 1—Section III, January 2, 1930, p. 52.

104. Packie, J. W.—"Distillation Equipment in the Oil Refining Industry." *A.I.Ch.E. Transactions*, Vol. 37, No. 1, 1940, p. 51.

105. Parker, F. D.—"Peace-Time Utility of War-time Petroleum Refining Processes." *California Oil World*, 1st issue, November, 1945, p. 7.

106. Parker, F. D. and Ragatz, E. G.—"Refinery Processes for War Products." *Petroleum Refiner*, Vol. 22, No. 12, December, 1943, p. 105.

107. Perry, Stephen F.—"Isomerization of Light Hydrocarbons." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 639.

108. Piroomov and Beiswenger—*A.P.I. Bulletin 10*, No. 2, Section II, 1929, p. 52.

109. Powers, P. O.—"Synthetic Resins and Rubbers." *Chem. & Eng. News*, Vol. 22, No. 22, November 25, 1944, p. 1992.

110. Pratt, A. W., and Foskett, N. L.—"Low Temperature Processing of Light Hydrocarbons." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 149.

111. Read, Davis—"Midget Fluid Cat Cracker Makes Process Economical for the Smaller Refinery." *The Oil and Gas Journal*, April 20, 1946, p. 144.

112. Reed, R. M.—"The Commercial Production of Pure Hydrogen from Hydrocarbons and Steam." *A.I.Ch.E. Transactions*, Vol. 41, 1945, p. 453.

113. Reed, R. M.—"Present-Day Hydrogen Manufacturing Processes." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 379.

114. Rosenstein, L.—"Synthetic Chemicals from Petroleum." Twenty-first Annual Meeting of American Petroleum Institute, Chicago, Illinois, November, 1940.

115. Russell, S. T.—"Buna S Rubber Program." *The Petroleum Engineer*, September, 1943, p. 84.

116. Russell, R. P., Murphree, E. V., and Asbury, W. C.—"The Production of Butadiene by the Dehydrogenation of Normal Butylenes." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 15.

117. Ryan, Paul—"Natural Gas Liquefication Process Enhances Hydrocarbon Reserves." *Petroleum Refiner*, Vol. 24, No. 4, April, 1945, p. 130.

118. Ryan, William F.—"Steam and Power Generation in the American Refinery." *The Oil and Gas Journal*, 1946, June 29, July 6, 13, and 20.

119. Saegebarth, E. O.—"Catalytic Reforming Process of Standard Oil Company of California." *The Petroleum Engineer*, May, 1946, p. 95.

120. Seaman, Robert G.—"The Canadian Government Synthetic Rubber Plant at Sarnia, Ontario." *India Rubber World*, Vol. 109, 1944, p. 587.

121. Simpson, T. P., Eastwood, S. C., and Shimp, H. G.—"Liquid-Charge Technique in T.C.C. Processing." *Petroleum Refiner*, Vol. 24, November, 1945, p. 110.

122. Skinner, Emory M.—"Experiences in the Commercial Application of the Hydrogen Fluoride Alkylation Process." *A.I.Ch.E. Transactions*, Vol. 41, 1945, p. 647.

123. Smith, D. J. and Moore, L. W.—"First Commercial Hydroforming Plant Now in Operation." *The Oil and Gas Journal*, March 27, 1941, p. 87.

124. Smoley, E. R. and Bowles, V. O.—"Some Considerations of Postwar Petroleum Refinery Operations." *The Petroleum Engineer*, May, 1945, pp. 113-123.

125. Smoley, E. R. and Schutte, A. H.—"Solvent Refining of Lubricating Oils." *Refiner and Natural Gasoline Manufacturer*, November, 1938.

126. Spencer, W. D.—"The Science of Coal to Oil Conversion." *Petroleum*, May, 1944, p. 76.

127. Strout, A. L.—"Some Developments in Commercial Cracking." *A.P.I. Proceedings*, Vol. XI, No. 1, Section III, January 2, 1930, p. 46.

128. Sullivan, F. W., Ruthruff, R. F., and Kuentzel, W. E.—"Pyrolysis and Polymerization of Gaseous Paraffins and Olefins." *Ind. & Eng. Chem.*, Vol. 27, 1935, p. 1072.

129. Swearingen, J. E., Geckler, R. D., and Nysewander, C. W.—"The Isomate Process." *A.I.Ch.E. Transactions*, Vol. 42, 1946, p. 573.

130. Sweeney, W. J. and Reeves, E. D.—"Refinery Plant and Engineering." *Petroleum Technology in 1939*, pp. 90-113.

131. Thomas, C. L., Anderson, N. K., Becker, H. A., and McAfee, J.—"Cracking with Catalysts." *Petroleum Refiner*, November, 1943, pp. 95-100.

132. Thomas, C. L., Anderson, N. K., Becker, H. A., McAfee, J.—"Cracking with Catalysts." *The Oil and Gas Journal*, November 11, 1943, p. 131.

133. Truesdell, Paul, and Lemen, W. E.—"Four Neighboring Refiners Install Joint Catalytic Cracking Unit." *National Petroleum News*, Vol. 37, June 6, 1945, p. R-410.

134. Van Antwerpen, F. J.—"Molecular Magic at Baton Rouge." *Chem. & Eng. News*, Vol. 21, No. 12, June 25, 1943, p. 950.

135. Van Antwerpen, F. J.—"Neches Butadiene Unit Opened." *Chem. & Eng. News*, Vol. 22, No. 5, March 10, 1944, p. 316.

136. Verity, P. S.—"Precise Fractionation." *National Petroleum News*, Vol. 37, No. 10, March 7, 1945. p. R-169.

137. Viland, C. K.—"Avon Refinery of Tidewater Associated Uses Many Processes in Manufacturing 100 Octane." *California Oil World*, March, 1945, pp. 5-14.

138. Wade, Henry N.—"High Pressure Absorption." *The Petroleum Engineer*, Reference Annual, 1946.

139. Wagner, C. R.—"Cracking Technology." *The Oil and Gas Journal*, September 2, p. 27; September 9, p. 66; September 16, (1943).

140. Watson C. C., Newton, Fred, McCausland, J. W., McGrew, E. H., and Kassel, L. S.—"Butane Dehydrogenation." *A.I.Ch.E. Transactions*, Vol. 40, 1944, p. 309.

141. Wickham, Henry P.—"Mechanism of Flow in Fluid-Catalyst Cracking." *Petroleum Refiner* July, 1945, p. 107.

142. Willcox, W. O.—"Houdry Research Seeks Development of Superior Catalyst." *World Petroleum*, Annual Refinery Issue, 1940, p. 52.

143. Willcox, W. O.—"Houdry Catalytic Processes Opening New Era in Refining Operations." *World Petroleum*, Annual Refinery Issue, 1939, p. 51.

144. Wilson, R. F.—"Technology as a Multiplier of Our Natural Resources." *Chem. & Eng. News*, Vol. 22, No. 10, May 25, 1944, p. 784.

145. Ziegenhain, W. T.—"Make Butadiene by Catalytic Dehydrogenation of Butane." *The Oil and Gas Journal*, August 20, 1942, p. 30.

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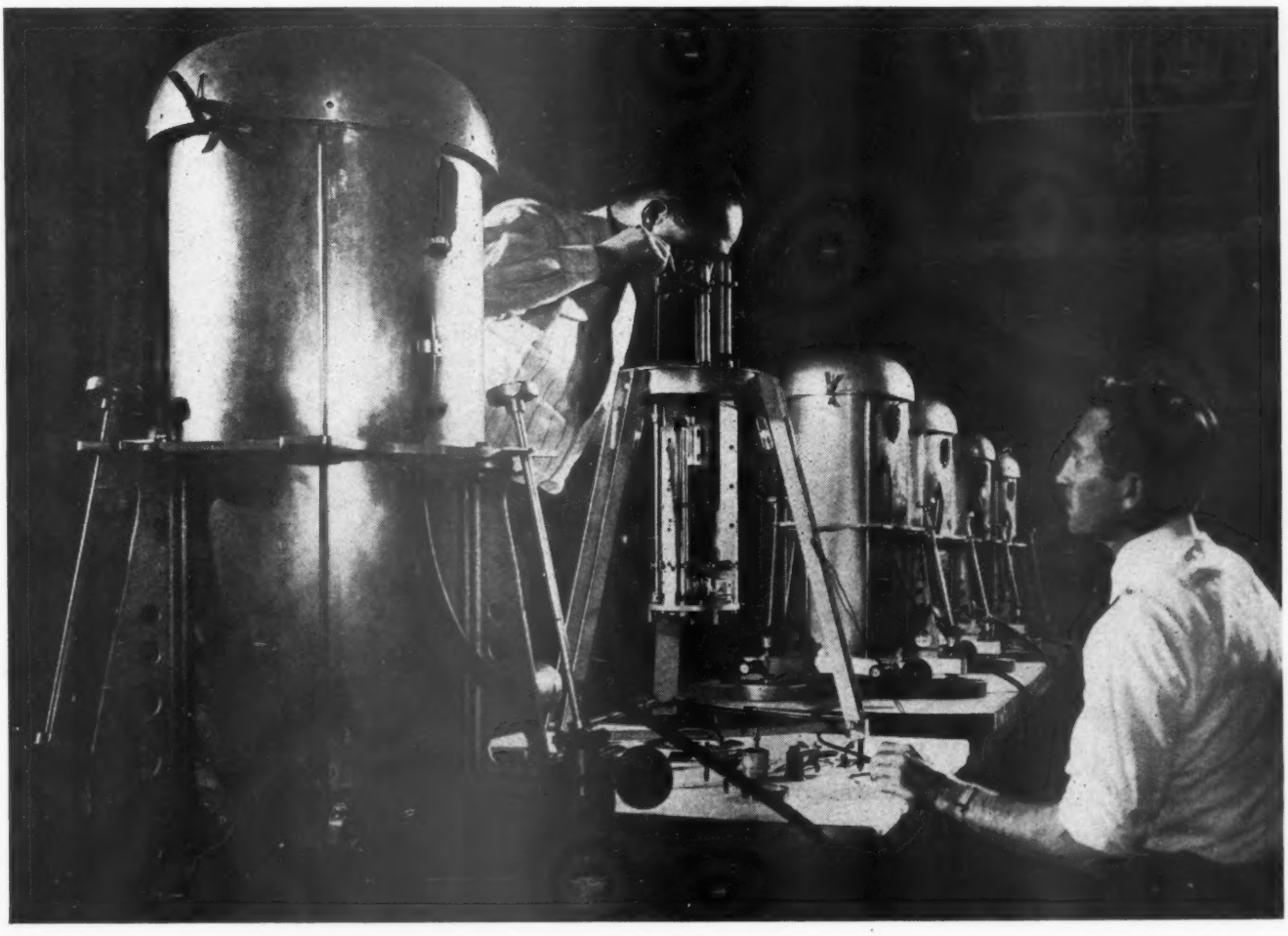
Research activities

Petroleum **Engineer Picture** *Story*

Time, space, materials—all are conserved in the Lilliputian world of the micro laboratory. Above, in Gulf Oil micro laboratory, one of the first in the petroleum industry, fuels are analyzed in quantities of 0.0001 to 0.00003 oz. The battery of equipment shown is for the rapid, automatic determination of carbon, hydrogen, and nitrogen in organic compounds. Materials are burned in the furnaces (the mounted, metallic cylinders) giving far quicker results than in testing with normal sized batches. Even the copper left on a man's hand after he has touched a brass door knob can be detected. So sensitive they can record the gravitational "tides" of the earth created by the attractions of the moon and sun, the gravimeters below, built in Gulf Oil Research Laboratories, Harmarville, Pennsylvania, are a major tool of oil exploration. Operated by gravimeter crews making 40 to 50 "stations," or recordings a day, these instruments chart the structure of sedimentary rock beneath the earth's surface by recording a profile of their gravity pull. From such a profile, geologists can locate structures of the type likely to contain oil. Gravity variations of less than 0.00001 per cent are distinguished by instruments in the laboratories.



One step in the constant battle of science to protect metals exposed to marine conditions from corrosion is revealed in this picture of a salt spray cabinet in use. Metal panels coated with experimental rust-preventive oils are subjected above, to a mist of synthetic seawater at a temperature of 100°F. The effect of months of exposure can be ascertained in a few days, enabling testing of thousands of oil compounds to improve protection from corrosion.

The glimpse through the windows of Gulf Oil research laboratories, below, shows in operation part of a battery of engines for determining octane number. Here new fuels are rated for octane and anti?knock number. Here new fuels are rated for this determination, those gasolines which pass the laboratory anti-knock specifications, are further checked in road testing before being offered to the public.

A scientist, above, checks the corrosion-resistance of oil-treated metal panels in a weatherometer or artificial weather-making machine. The panels are subjected to maximum temperatures of about 140°F., rays of ultra-violet light of an intensity 10 times that of noon-day sun, and intermittent water spray. Thousands of rust-preventive petroleum compounds may be tested in a fraction of the time required in actual exposure.

★★★

Meter building anchor

By **O. C. IRVINE,** United Gas Pipe Line Company

THE small metal meter houses in use in natural gas field and gathering operations are essentially of light construction, and unless they are properly anchored are a "pushover" for any high wind that might happen along. Until recently, United Gas Pipe Line Company field and section foremen in the Shreveport, Louisiana, area encountered considerable trouble in mounting meter houses on sufficiently heavy foundations to hold the structure in place during windstorms and at the same time prevent settling of the building, which causes doors to become hard to open and close.

EXCLUSIVE

Then Schley C. Osborne, field and section foreman in United's Waskom-Bethany area, came up with the idea illustrated in the accompanying panel of pictures to virtually "cure" this difficulty in meter house installation. He is shown in the lower right photograph beside one of the buildings being installed in his territory.

Osborne conceived the idea of welding the metal framework of the meter house to a piece of junked 4-in. pipe, approximately 8 ft. long, at the front and back sides of the house. This adds 86.3 lb. to each side of the meter house, a total of 172.6 lb. of deadweight ballast. The pipe is covered with earth to within 1 in. of the top, becoming in effect a "dead man" to hold the building in place against strong winds. It is left open ended so that sidewise shifting is offset by the tendency to dig in.

Mounting meter houses in this manner has been found to prevent settling to a great extent, and still another advantage is that the bottom edge of the metal walls are elevated above the soil as a protection against rust and corrosion.

The cost of pipe used, on a junk price basis, is approximately 60 cents for each building, much cheaper than concrete blocks can be made to accomplish the same purpose, and the pipe makes a more satisfactory anchoring foundation.

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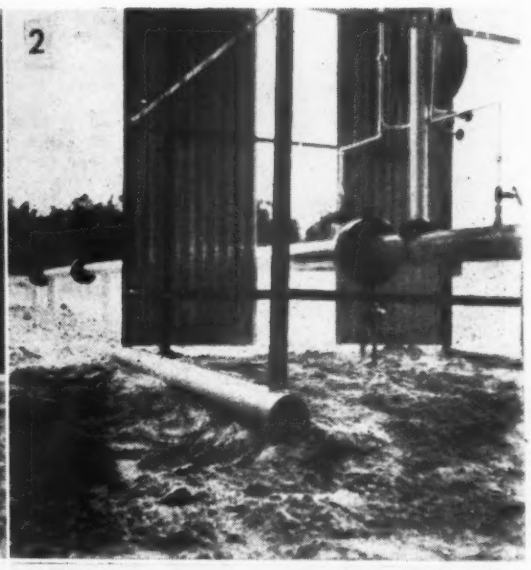
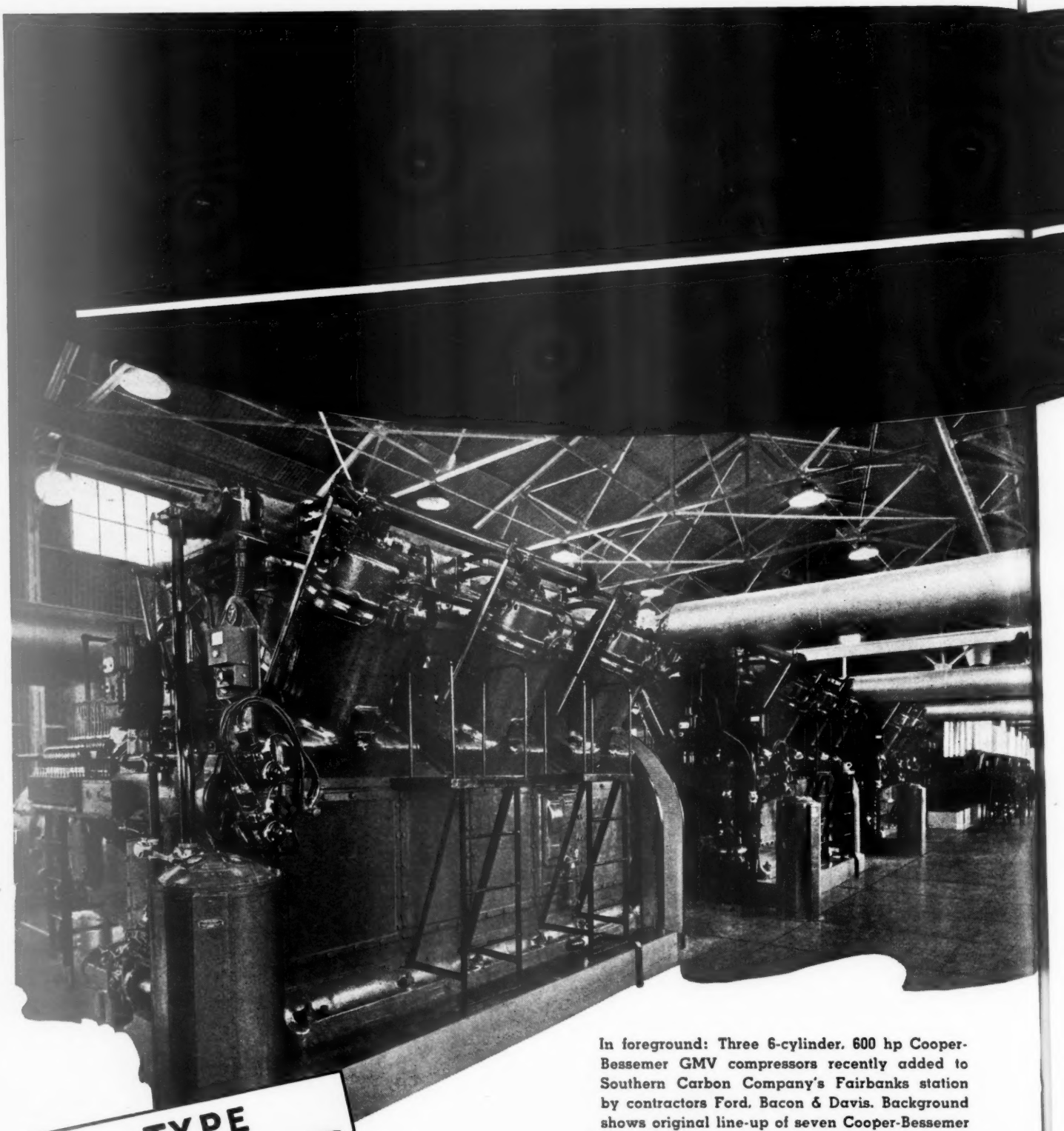
1. Side view of meter house construction, designed to stay in place during wind storms.



2. Junked 4-in. pipe welded to the front and back of the house provides deadweight ballast to hold it in place.

3. The meter house is left with open ends so that sidewise shifting is offset by tendency to dig in.

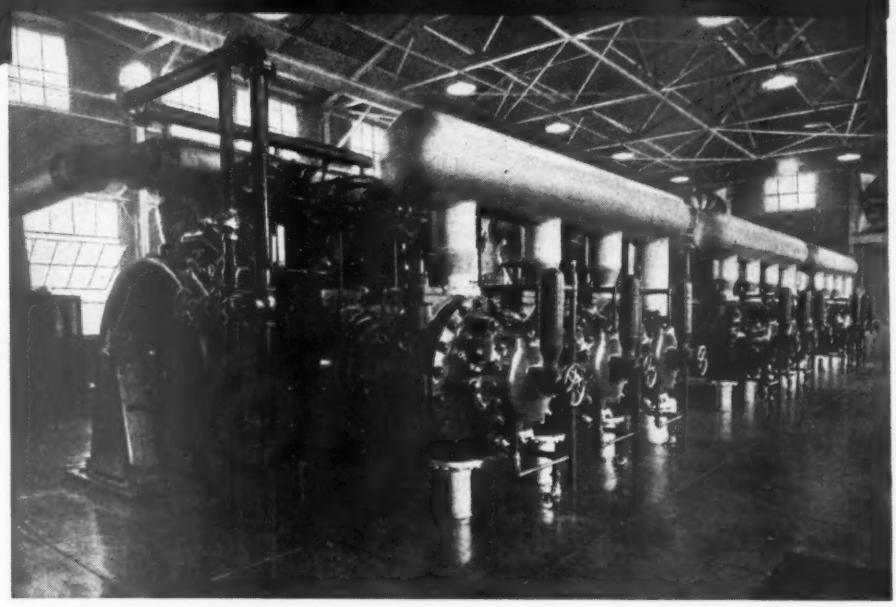
4. Schley C. Osborne, section foreman, who designed the meter house installation.



In foreground: Three 6-cylinder, 600 hp Cooper-Bessemer GMV compressors recently added to Southern Carbon Company's Fairbanks station by contractors Ford, Bacon & Davis. Background shows original line-up of seven Cooper-Bessemer horizontals, now in their eighth year of service. Station also has four Cooper-Bessemer Type GAW gas engines driving 100 KW AC generators for auxiliary power service.

TYPE GMV ANGLE Compressors

New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash. Shreveport



Southern Carbon Company's three new Cooper-Bessemer GMV's shown from the compressor side. Installation of these modern units, each driving 3 compressor cylinders, doubles compressor horsepower at the Company's Fairbanks station.

Eight years ago, seven Cooper-Bessemer horizontal compressor units were installed in Southern Carbon Company's station at Fairbanks, Louisiana, for gas transmission from the Monroe field. Although provision had been made for the field's decreasing pressure, it was decided last year to add more compressors, to help compensate, and to greatly increase output. Again Cooper-Bessemers were installed . . . this time three modern, compact V-angle GMV's, adding 1800 horsepower — more than provided by all seven horizontals.

Modern design and construction plus highly advanced operational features make the GMV exceptionally versatile and flexible. It is at home in all kinds of gas transmission and oil field pressuring service, is also ideal for processing work in refinery, chemical and synthesis service. Available with 4, 6, 8, and 10 power cylinders, the GMV meets all requirements from 400 to 1000 hp, is readily equipped with Cooper-Bessemer compressor cylinders for any combination of volumes and pressures within the horsepower range. Ask for the new 48-page GMV Bulletin No. 337.

by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Houston, Dallas, Greggton, Pampa and Odessa, Texas Tulsa St. Louis Los Angeles Caracas, Venezuela

Synthetic fuels made from dry gas

RESEARCH in synthetic fuels has recently stressed the use of dry gas. One of the pilot plants operating is that of the Standard Oil Company of New Jersey at Baton Rouge, Louisiana. This experimental synthetic oil unit stands about seven stories in height and is small compared to an oil refinery.

The yield of 10 bbl. or so daily is playing its part in piloting research toward fuels of the future. Although proved reserves of petroleum in the United States are currently at the highest point in history, the exploration of possibilities to add to the reserves with synthetic fuels is important in the economic picture. These can be produced from abundant supplies of natural gas, coal, oil shale, and tar sands.

In this Standard pilot synthetic fuels are produced from natural gas and are substituted for natural petroleum products in running internal-combustion engines.

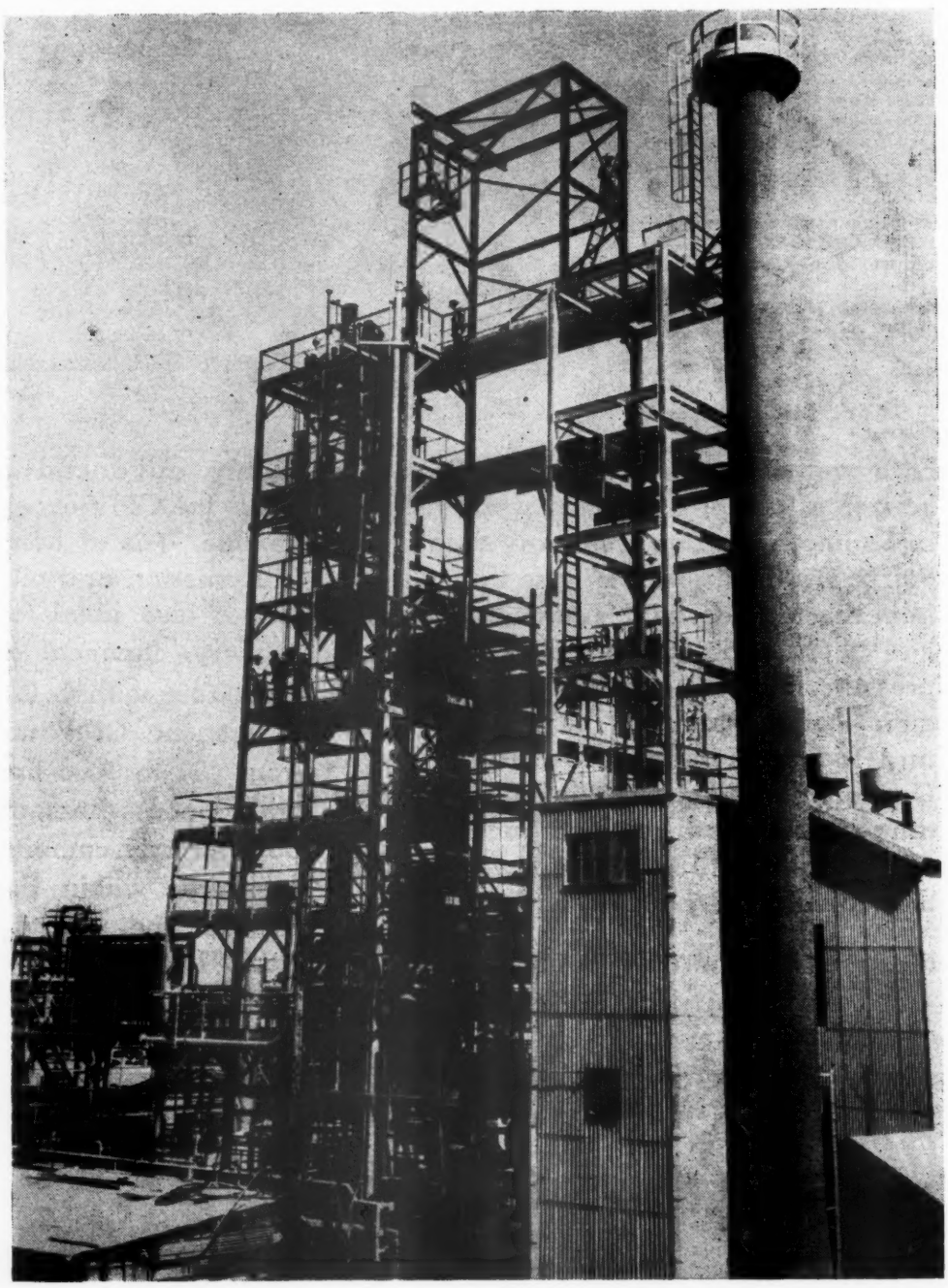
Working with natural gas, the Esso Laboratories produced both the synthetic gasoline and synthetic diesel fuel by the hydrocarbon synthesis process, which is a further development of the basic fluid catalytic technique used by Standard.

This technique was developed by Jersey Standard scientists and engineers and was the method for production of 100-octane aviation gasoline during the war. Started before the war, the work on oil synthesis was discontinued during the war in favor of more urgent research.

At the Baton Rouge plant operational methods are being tested so that large scale units will eventually produce fuel for automotive equipment of all kinds. These synthetic fuels are made from natural gas now but the process is applicable to coal as well and when perfected can serve to extend liquid fuel supplies indefinitely.

Recent demonstrations of the synthetic fuel were staged by the Army-Navy Petroleum Board at the Naval Engineering Experiment Station. Barrels of synthetic gasoline and synthetic diesel fuel were supplied by the Esso Laboratories, the scientists using the Baton Rouge plant for the purpose. The fuels had to meet Navy specifications; for instance the gasoline had to be 80-octane rating, matching the all-purpose gasoline used by U. S. Army vehicles during the war. ★★★

The workmen on the structure are installing a vertical reactor in which the synthesis is carried out. The unit is about seven stories in height.



Laboratory testing of emulsified oil

By **LOUIS T. MONSON**

Tretolite Company of California

EXCLUSIVE

CRUDE oil emulsions of the "cut oil" type may contain as much as 90 per cent water as produced, distributed wholly or in part as fine droplets throughout a continuous body of oil, as stated in a preceding article*. They may also contain some sand, silt, drilling mud, or other inorganic sediment.

Inasmuch as the purchase, sale, and transportation of crude oil usually involve common carriers, such as pipe line companies, certain specifications have been established to govern the maximum permissible amounts of water, emulsion, and sediment in acceptable crudes. That these limits are quite strictly followed will be attested by any producer who has had a tank of oil rejected by the pipeline gauger because it contained 0.1 per cent more impurity than specifications permitted.

Certain test procedures have consequently become standardized to determine the specifications of crude oil. Sometimes these are merely the agreed practices of the parties to a purchase contract. At other times they are so widely applicable that they have been adopted by standards associations and are relied on in all instances where contrary procedures are not specified.

Two procedures that have been employed for many years for determining impurities in crude oil are distillation with a suitable solvent and centrifuging in calibrated tubes. Each of these has its shortcomings. Water-by-distillation is just that; the water content of the sample is determined but the salt, sand, silt, scale, and other non-volatile impurities are not determined. Consequently the result obtained is sometimes lower than the value for total impurities.

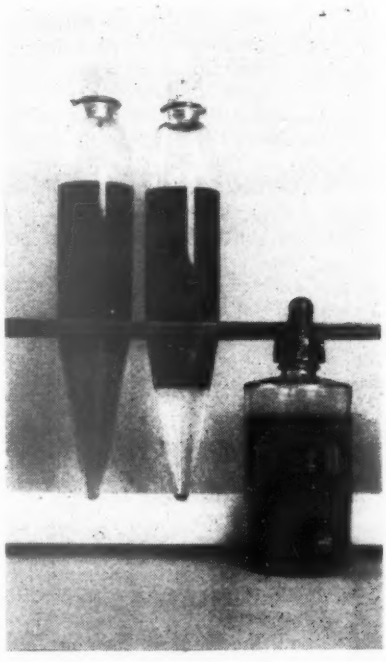
● **Centrifuge testing of emulsified oil.** The centrifuge method, exemplified by ASTM Method D 96 for water and sediment in petroleum products, is much more commonly used for the foregoing reason and also because the equipment required is more rugged and more regularly available. In this method a representative sample of the crude oil is diluted in a centrifuge tube with benzol (other non-aqueous solvents are frequently substituted in variations of the procedure) and centrifuged for a specified time after heating. The calibrated tube may then show a top oily layer, a layer of unresolved emulsion, an aqueous layer, and a bottom solid layer. The volumes of the lower layers are reported as emulsion, water, and sediment, respectively, or sometimes simply as "BS&W" or "M&BS" meaning total emulsion-and-water or total moisture-and-emulsion, respectively. It will be noted such terms do not mention mineral sediment specifically.

The method is admittedly unsatisfactory in certain respects. For example the ASTM states in a note attached to the printed method:

> *"A centrifuge method for determining water and sediment is not entirely satisfactory because the amount of water obtained is nearly always lower than the actual water content."*

Unresolved emulsion remaining in the tube after centrifuging contains an appreciable proportion of water. In more refractory emulsion samples the compacted emulsion mass in the tube may contain only 10 per cent or even less water. Ordinarily it will contain 50 per cent to 65 per cent water. In unusual cases, especially in the presence of mineral matter, the compacted emulsion in the tube may contain 80 per cent or even 90 per cent water. In some instances it is extremely difficult to precipitate the emulsion satisfactorily even on long spinning because of the fineness of the emulsion particles. It may even be impossible to obtain a satisfactory interface or "line" between the oil and emulsion layers in the tube.

Centrifuged oil sample, showing effect of chemical demulsifier.



If a deduction is made for all emulsion remaining unresolved after centrifuging, the seller realizes less than he should from the sale because the remaining emulsion contains an appreciable proportion of oil. If it is all considered oil the buyer is buying a certain minor proportion of water concealed in the remaining emulsion.

The word "sediment" in the method is of variable meaning. If it pertains to unresolved emulsion, the foregoing discussion is relevant. If, as used through the present discussion, it means mineral matter, like formation particles, sand, silt, or drilling mud solids, the value reported may still be fallacious because:

Mineral sediments have densities well over 1.0. In other words, if freely subject to the action of gravity they should settle to the bottom of the tube below the oil, emulsion, and water layers. But if they are oil-soaked or oil-coated the density of the oil-soaked mineral particles may lie anywhere between the density of the oil and the density of the unoiled solid material. In other words the oiled particles could float above the water, sink through the water, or even, in rare cases, remain suspended in the water if their density exactly equalled that of the water in the tube.

From these facts it is apparent that the value reported for mineral sediment will be low by the amount of the mineral matter that is concealed in the oil and emulsion layers in the tube. It will be high by the amount of oil contained in the sediment layer below the water layer. Sometimes the sediment content of the emulsion layer is quite evident in the ragged interfacial line between the emulsion and water layers. Similarly the presence of oil in the sediment layer is indicated by a ragged interfacial line between the water and sediment layers.

The same chemical reagents that are useful in dehydrating cut oil on a commercial scale in the field are equally applicable to analytical laboratory procedures of the present kind. The process is broadly similar to that employed in using them in the field. The products of the test, if the procedure is properly devised and properly used, are clean oil, free water, and mineral sediment, if any.

The procedure at present specified in ASTM Method D 96 may be followed in detail with this single exception:

The oil sample and the diluent are first introduced into centrifuge tubes, which are shaken to mix the liquids and then heated in a water bath, all as specified in Section 4 (a) of the standard method.

Then, before proceeding with the operations of present Section 4 (b), this preliminary procedure is suggested:

> The centrifuge tubes shall be removed from the bath, and there shall be added to each the smallest effective amount of a suitable resolving agent. The tubes shall then be re-stoppered immediately, and shall then be shaken 200 times, to distribute the resolving agent thoroughly. The tubes shall thereupon be returned to

*"Observations on the Chemical Demulsification of Crude Oil," by Louis T. Monson, *The Petroleum Engineer*, September, 1946, page 69.

the bath for a period not less than 10 minutes. They shall then be removed from the bath and shaken 200 times.

The procedure of centrifuging, as presently recited in Section 4 (c), is then followed after the emulsion in the sample has been destabilized as recited.

The only possibly ambiguous parts of the suggested procedure are the definition of "a suitable resolving agent" and determination of "the smallest effective amount" of such reagent, to be employed. These points can be clarified by a footnote of the following nature:

> Note—Resolving Agents: The resolving agent shall preferably be the commercial product employed in resolving commercially the emulsified oil of which the sample is a representative specimen. This reagent shall preferably be dispersible permanently in benzol in concentrations smaller than 0.5 per cent. If so, it may be incorporated in the benzol employed as diluent in the test. If not, it shall be used in the form of a benzol or xylol solution or dispersion, of such concentration as may be required to produce a permanent non-separating mixture. It shall not be employed in dispersion or solution in water or other aqueous solvent, regardless of whether it might be so employed commercially. The total volume of benzol and resolving agent employed in making the test shall be 50 ml. of which the resolving agent shall not exceed 0.1 ml.

It is quite possible that in the majority of instances where the centrifuge test is employed operators do not observe all the precautions or practice all the steps set out in the standard method. They have found that shorter spinning periods, less (or no) heating, or other short cuts do not invalidate their results and they have modified the standard procedure accordingly. Sometimes with viscous oils a 25 ml. sample and 75 ml. of diluent are employed instead of the 50-50 proportions specified in standard method.

The strict language of the standard method is not always complied with in many laboratories, especially in field laboratories. Heat may not always be required or it may be unavailable. Benzol is not an ideal diluent from density and availability standpoints. Gasoline is commonly employed and special solvent mixtures, like gasoline-carbon disulphide or gasoline-carbon disulphide-phenol, are often used. The proposed method is equally applicable when such substitute diluents are used. Variations in these and other details of the standard method and procedure are equally practicable when demulsifying agents are used as suggested, as when they are not. The author has used the proposed method for years employing the demulsifier in 25 per cent xylene solution (because of xylene's relatively low volatility as compared with that of benzol).

It is desirable to use as small a quantity of "cutting solution" as will resolve the emulsion. Ordinarily, not more than 3 or 4 drops of the diluted reagent are required for use with 50 ml. of oil sample. Because 4 drops represent about 0.20 ml. and because the solution contains 25 per cent of reagent, use of 4 drops of cutting solution with 50 ml. of oil sample is equivalent to employing about 0.05 ml. of undiluted reagent, for a chemical-to-emulsion ratio of about 1:1,000. As usual field ratios of chemical-to-recovered oil approximate 1:10,000, this is obviously an ample excess for resolving ordinary emulsions in the test procedure.

Unusually stubborn emulsions may require more reagent, but additional mixing by shaking or additional settling before centrifuging, especially at somewhat elevated temperatures, will usually obviate the necessity for using larger proportions of reagent.

It is sometimes desired to add the demulsifying agent to the whole volume of diluent available so that use of a dropping bottle to meter the small volumes of chemical required for individual tubes can be avoided. A second purpose in such a proposal would be to prevent careless use of excessive amounts of demulsifier. Any such proposal should be accepted only after it has been definitely established that the chemical will produce a permanent dispersion or solution in the diluent in the concentration in which it will be present. Operators have sometimes been too ready to believe the chemical was soluble and usable in this fashion because separation was slow or was otherwise difficult to detect.

Experimentation by the operator can easily develop a technique that will prove satisfactory for use on even the more refractory emulsions. This is especially true where samples from a single source or a limited number of sources are being run for control purposes. The centrifuged sample should not show any unresolved emulsion if proper conditions of test have been established. (Wax should be clearly differentiated from emulsion, of course. Warming is helpful in this respect.)

The picture shows two centrifuge tubes containing wet crude oil after centrifuging. The lefthand tube has been subjected to the present standard centrifuge technique. It contains, successively, a top layer of oil, an appreciable emulsion layer, and only traces of free water and sediment. The righthand tube represents a sample of the same crude processed according to the above-described method using a commercial demulsifier. Note that it contains only oil, free water, and sediment. The emulsion layer, of indefinite composition, has been resolved completely into oil, free water, sediment.

The suggested technique is being incorporated into an increasing number of oil purchase contracts. Both buyer and seller are aware that emulsion percentages are ambiguous and that an arbitrary estimate of the oil content of such emulsion may be unfair to either of them. When the sample is resolved completely into oil and water there can be no controversy.

Field gaugers are using the "chemical-centrifuge" method of testing because it enables them to make a more accurate appraisal of the samples they test. By using it they will not mistake wax for emulsion and reject tanks they should accept. On the other hand they will not make the mistake of accepting tanks wherein the oil is so stably emulsified that all the emulsion will not centrifuge to the bottom of the tube in the standard spinning period. Such oils do exist and have sometimes been accepted as clean when actually they still contained excessive percentages of water.

● **Determination of dry oil gravity.** A technique that may be employed in the laboratory to determine the dry gravity of crudes is especially useful in the case of newly-discovered areas where the operators desire to know the quality of the oil they have struck but where it may be carrying drilling mud and drilling water in such volumes as to make a direct gravity determination valueless.

When oil contains appreciable proportions of water or mineral sediment its API gravity is reduced. A determination of the true or dry gravity of the oil is therefore required to predict the price at which the clean oil may be sold. Dry gravity may be determined in the laboratory by using the chemical demulsifiers used commercially and a technique somewhat similar to that employed in field dehydration.

Any desired volume of emulsified oil is measured into a container capable of being closed tightly. Pipe fittings are suitable although they may sometimes be found undesirably heavy and bulky. A small amount of cutting solution of the kind described above in conjunction with the centrifuge test is added. It is practicable to employ as much cutting solution as 1/200 the volume of emulsion sample used. The small amount of solvent present in the cutting solution does not materially affect the oil gravity. An excess of cutting solution should in general be avoided as above.

The container is closed securely and is alternately warmed to 120°F. and shaken for several minutes as required to obtain complete resolution of the emulsion. The container is allowed to stand at an elevated temperature until the water has separated from the emulsion and has settled.

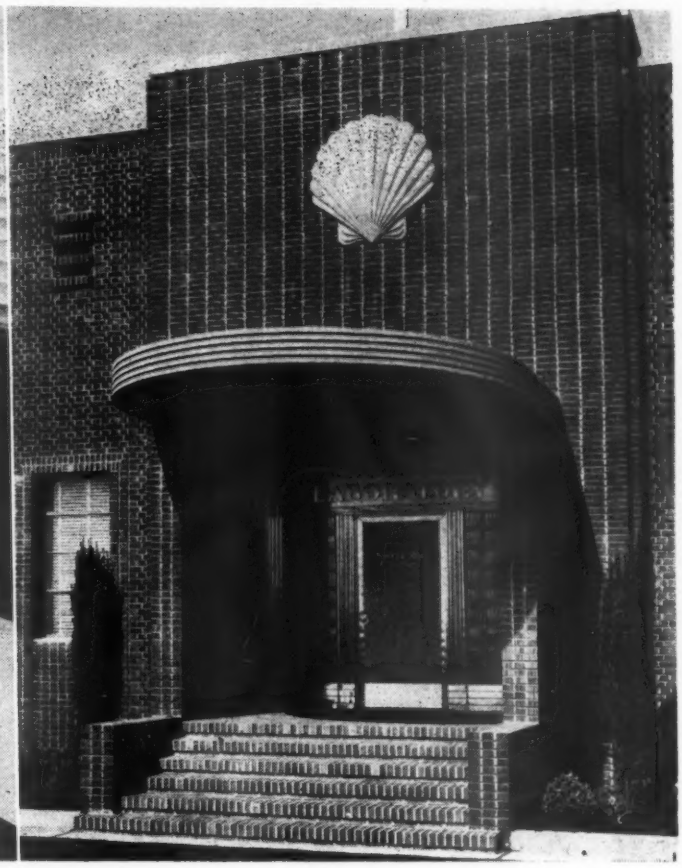
The container is allowed to cool completely before being opened, to retain the more volatile constituents of the sample. The water and oil layers are separated and the gravity of the recovered oil is then determined by any suitable method, e.g., by hydrometer.

To confirm the completeness of resolution of the emulsion in the sample a portion of the recovered oil should be subjected to the centrifuge test, above outlined. It will usually be found that the recovered oil contains only a trace of water and other impurities if the method has been applied with reasonable skill.

As was stated above in connection with the proposed centrifuge method, variations in procedure may be employed where experience dictates. The important objective of course is complete resolution of the emulsion so that a clean dry oil sample may be obtained for the gravity test.

A chart showing the improvement in oil gravity obtainable by removing different percentages of water from crude oil may be procured from the author without obligation from 5515 Telegraph Road, Los Angeles 22, California. ★★

Roy Hansberry, director agricultural laboratory.



Imposing entrance to Shell's lab at Modesto.

Petroleum and agriculture team up to speed new scientific development

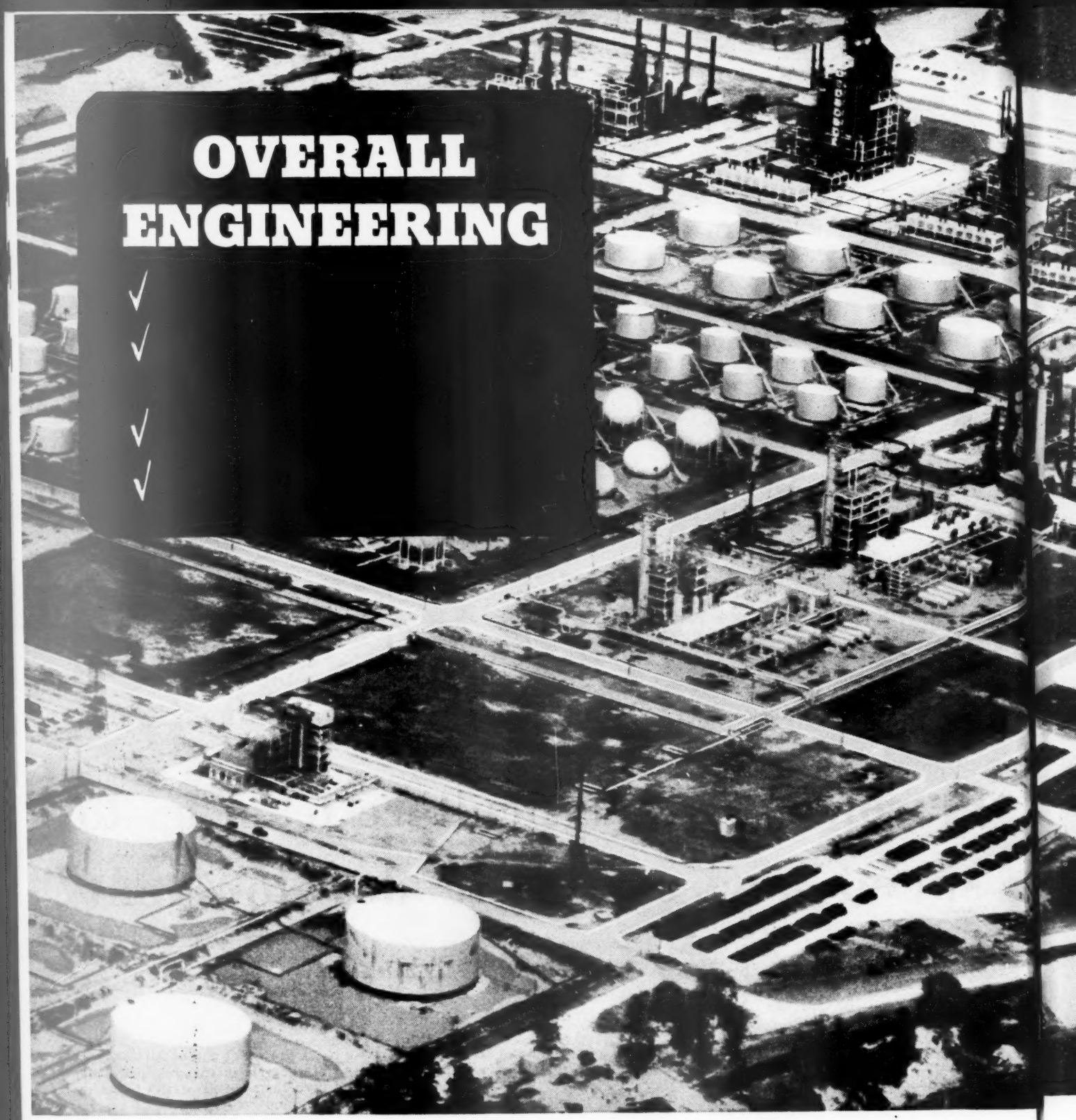
By **RICHARD SNEDDON,** *Pacific Coast Editor*

NOTHING could emphasize more fully petroleum's expanding sphere of influence than Shell Oil Company's recent contribution to the scientific development of agriculture —a half-million dollar laboratory, equipped with every facility for the study of crop culture and conservation, and manned by experts in all phases of the highly diversified activities that such a project entails. This great institution, covering with its grounds approximately 142 acres, is situated near Modesto, California, in an area peculiarly suited to the type of research in which it will henceforth be engaged. It is under the direction of Dr. Roy Hansberry, one of the nation's leading entomologists, a man who is admirably qualified both by education and experience to extend the useful application of petroleum and its derivatives in agriculture, the most fundamental of all industries.

EXCLUSIVE

Offhand, it might seem that the petroleum technologists are here branching out into a new field of service, but that is far from true. Actually, it is many years since the petroleum hydrocarbons first began to find a place in the composition of sprays for insect and fungus control, and to be employed as a vehicle for various inhibitors and other essentials of the agricultural arts. Agronomists had long studied the effects of soil constituents, climatic conditions, and a multitude of pertinent factors on crop growth and yield. Chemicals of infinite variety had been utilized to destroy parasites without deleteriously affecting the plants on which they prey. They had been used, also, to stimulate growth of a desirable nature, and to check growth of an undesirable type. In this program of research, petroleum had been the source material for many products and commodities that are indispensable in modern methods of pest control and crop stimulation.

With the development of these agricultural aids, it has become a responsibility of the petroleum chemists, physicists and other technologists, to familiarize themselves more and more with the processes and problems of the growers. In fact, recognizing the basic essentiality of agriculture in the national economic scheme, and the importance of crude oil as a source of many urgently needed and highly useful derivatives, the oil industry has not hesitated to employ agricultural specialists of all sorts to aid and advise in its investigations and researches. The expansion of this type of service naturally involved



OVERALL ENGINEERING and construction by one organization pays many dividends—initially and throughout the life of the equipment. This is true in building complete new refineries or in modernizing complete process phases of existing refineries.

1st, most refinery units are interdependent, handling products of, or preparing feeds for, other units. Overall engineering insures that the same performance tolerances will be built into all process units. Thus *all* equipment will be "in balance"... can be operated at peak performance levels.

2nd is the beneficial effect overall engineering and construction by *one* organization have on the *final total* of initial investment. Field labor costs can be minimized through elimination of competition for skilled labor at the site, and through more economical use of this labor. Reduced field accounting expense, and reduced cost of rental and replacement of tools which do not have to be duplicated by two or more concerns are other benefits. But affecting initial investment, probably more than any other factor, is the improved quality of personnel which can be assigned to top supervision when *one* organization undertakes a project of sizeable scope.

3rd, maximum simplification of piping layout and design, pumping facilities, etc.—possible only through overall engineering of several units—contribute to lowered maintenance.

The 100,000 bbl. refinery of Cities Service at Lake Charles, La.—a notable example of overall engineering.

However, this saving is not as immediately apparent as the reduction in the maintenance-parts inventory where *one* organization reduces the types and makes of pumps, valves, motors, etc., to a minimum. Customers can of course specify these items, but then responsibility for their performance must also be accepted.

4th and probably the most important consideration of all, is the fixing of responsibility on *one* organization. Where more than one organization is involved there is bound to be some place in the job where the customer "holds the bag" . . . a position that can affect the economics of a refinery operation adversely for a considerable period of time in case something does go wrong.

Thus, in the final analysis, just as "there is no substitute for the best design" to enjoy low manufacturing costs with concurrent high quality products—so "there is no substitute for overall engineering with undivided responsibility" to obtain maximum returns on every dollar expended for the expansion or modernization of refining facilities.

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frequent consultations with farmers, orchardists, state agricultural institutions, and other cultivators of the soil, and eventually led to the use of the farms and orchards themselves as proving grounds for theories, methods, and products of great variety.

During the war, the race for fuel superiority became so keen that tremendous strides were made in petroleum chemistry, particularly in the synthesis of a wide range of organic compounds from the petroleum hydrocarbons. Although, at the moment, the new-found techniques were largely utilized in the preparation of combat materials, it nonetheless became obvious that they had opened ways to the acceleration and advance of many peacetime pursuits. Agriculture, of course, is more than a peacetime pursuit. It is the very aorta of human existence; but, in any case, it was one of the basic industries that stood to profit by the progress in synthetics from petroleum, and because petroleum and agriculture had long been teammates, it was only a question of time until they would resume their briefly interrupted effort in cooperative enterprise.

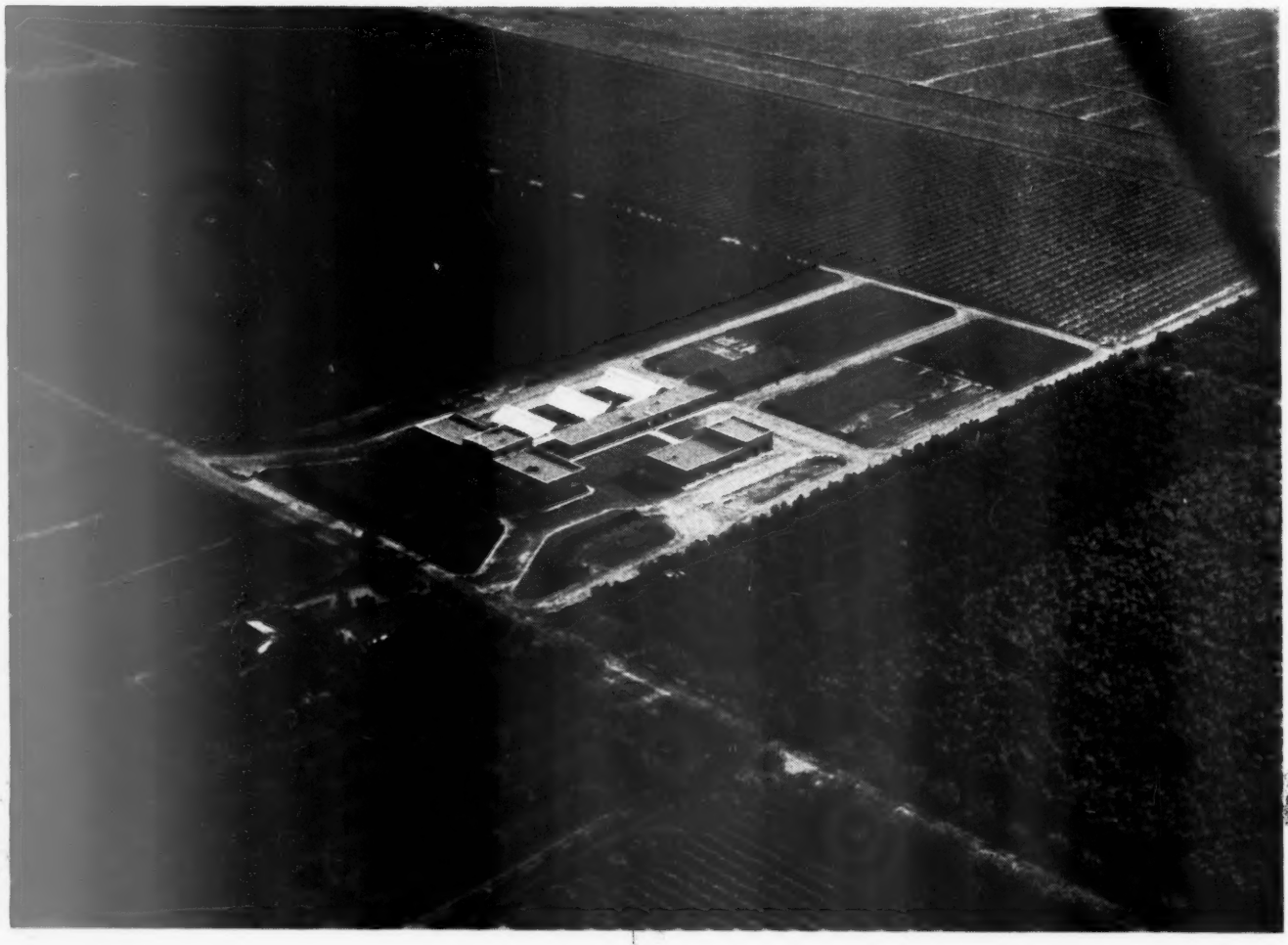
When the war ended, and all business was faced with the headache of reconversion, this blossoming relationship with agriculture was a prime consideration in the plans of the large oil companies. It had by this time assumed sizeable proportions, and was giving such promise of further healthy expansion that its semi-detachment from the general research department seemed an entirely rational move. Thus, the Shell Oil Company's agricultural laboratory at Modesto constitutes a simple recognition of the fact that the opportunity for related service in the agricultural field is now too big and too specialized in character to be made a side issue of ordinary petroleum research. Indeed, there is now no such thing as "ordinary" petroleum research. Progress in all phases of the industry itself, and in related industries, has so expanded. and the general scope of application has so enlarged, that it is now necessary to institute a whole series of subsidiary laboratories each devoted to a specific type of research, and all under the control and direction of some form of executive research board.

The Shell Oil Company property at Modesto was purchased in July, 1944, and ground was broken for the new laboratory in September, 1945. Plans have been completed in the meantime for such additional structures as ranch houses, warehouses, a fruit handling building, and several others, all of which will be built as soon as materials are available. Fifty acres of old fruit and nut trees have been cleared away, the ground has been releveled, and an underground irrigation system has been installed. Up to the present time, more than $500,000 have been invested in the project, which was formally opened and dedicated to the advancement of agriculture a few weeks ago.

As already stated, it is comprised of some 142 acres, divided into 100 acres of trees and vines of many commercial types, 30 acres of truck crops, and 12 acres for buildings and roads. The staff consists of about 50 men and women, including the scientific and administration groups, and the ranch crew. The function of the institution, according to Dr. Hansberry, is three-fold, as follows: "Most important, it is a research institution for developing new ideas. It is also a proving ground for natural and synthetic products made from petroleum. Finally, it is a clearing house of scientific knowledge and information, where farmers' problems may be presented and solved."

The simple truth is that farming in all its phases has followed the common trend of industry, and has become intensely scientific, so much so that the availability of some sort of research and development service is essential to the economic conduct of a modern farm or

Aerial view of Shell agricultural laboratory, center, and part of 142-acre experimental farm. Half a million dollars has already been invested in this modern institution.



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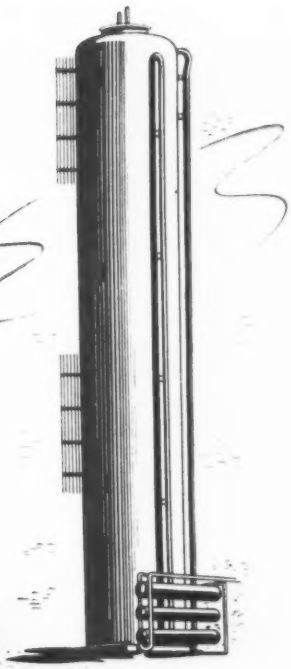

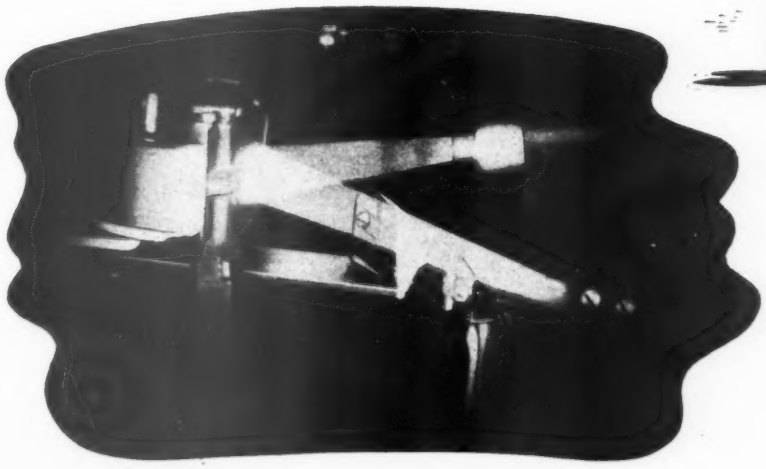

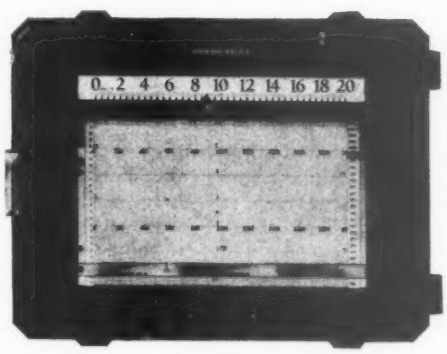

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Above—**A combination library and conference room in the laboratory may be used for staff meetings or consultations with farmers.**

Below—**Clyde W. McBeth, nematologist, and Joy McCarty, assistant, check plant specimens for the presence of nematodes, microscopic soil-infesting organisms that attack plant roots and reduce yield.**

orchard. In making available unusually complete research, development and advisory institutions, the petroleum industry is merely expanding an interest and an effort that have been growingly evident down through the years. Thus, the new Shell agricultural laboratory represents the consolidation and concentration of many activities, the acquisition of new facilities and personnel, and the correlation of all these instruments and activities so that the total effort shall be more effective.

It is now a well recognized fact that although the accomplishments of the past in agricultural research, specifically that part of it in which the petroleum industry is involved, have been quite substantial, the opportunities of the future are tremendous. The petroleum industry and the growers alike realize that they have scarcely scratched the surface of scientific operation up to the present. There are many problems still to be solved, and many commodities and processes to be improved. Millions of dollars annually are still lost to the growers through soil deficiency conditions, and the depredations of blights, insects, diseases, and other pestiferous influences. All this constitutes a challenge that science could not very well ignore. It is an endless battle in which the period of metaphorical lend-lease is over, and the petroleum industry is now fully allied with agriculture.

A few years ago, substances used to combat farm pests were largely inorganic, such as cyanides, arsenates, and various sulphur gases and compounds. These were largely dissolved in water and used as sprays, and the techniques involved permitted the operators to be exposed at least to some degree. This, of course, in the use of highly poisonous materials was distinctly dangerous, and, thus, very undesirable. In present day practice, the safety of the operator is of paramount importance, and every effort is made to protect him to the maximum extent.

It was unfortunate, also, that farm animals, and good as well as bad insects and birds, were often affected as much as the intended victims by the sprays in the early period of their use. With the development of organic reagents, however, there came a greater selectivity and fewer unwanted effects. Solution or suspension of many of these newer reagents in petroleum liquids at the same time gave them greater penetration and spreading power than the old water solutions, and, indeed, they had many advantages over their predecessors. The search for additional chemicals, as well as information valuable in diverse agricultural operations, goes on vigorously, and the Shell Oil Company's Modesto laboratory is designed to expedite this search, in which

Agricultural engineer, Merrill L. Adams, specializes on development of equipment for any new need and improvement of existing devices—a sizeable assignment.

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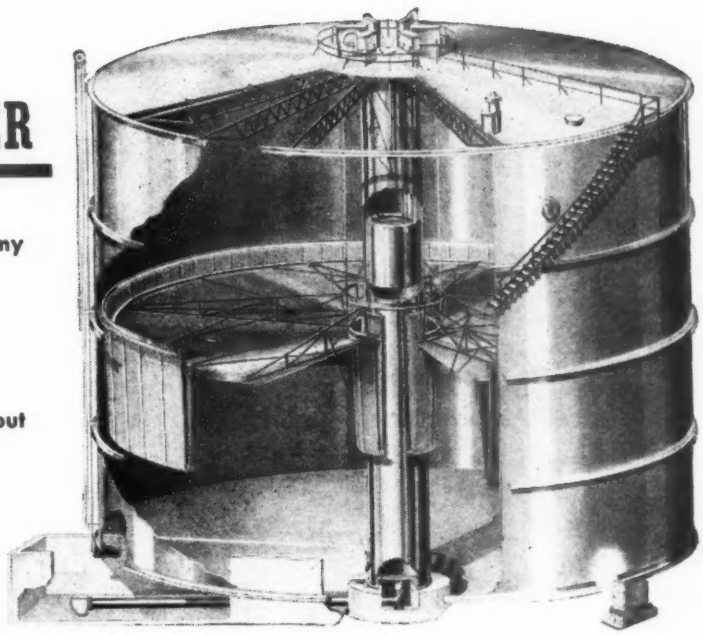

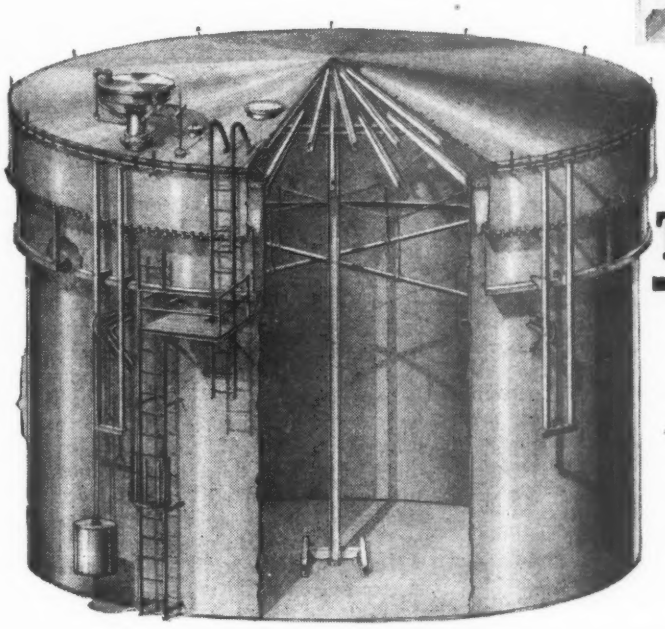

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Ranch foreman, Owen B. Chamberlain, inspects a peach-thinning job.

Men spray an orchard prior to harvesting to control mosquitoes.

it will be aided by the main laboratories of Shell Development Company at Emeryville, California.

Indicative of the growth of this phase of petroleum industry development is the fact that the agricultural laboratory must itself now be departmentalized in order that its various researches might be advanced to the fullest extent. In the new Shell laboratory, each department manager is not only a recognized authority in his field but is also thoroughly versed in practical farming. The department of entomology is devoted to the control of crop-destroying insects, and the study of methods by which plants may become resistant to the attacks of insects and parasites. It is well known, for instance, that DDT is a potent commodity for insect control, but for the scientist, the mere discovery of DDT immediately poses a multitude of new problems. How much to use in each particular instance to contrive the most desirable effect? What concentration is advisable? What carrier? What are its effects on other organisms? Every kind of fruit and vegetable has a mite, or a worm, or an insect, trying to prevent its getting to market, and the entomologist wages a constant fight against these despoilers of the farmers' income. Numbered among his most effective weapons are petroleum and its derivatives.

The department of nematology is designed to prevent, insofar as possible, the spoilage that is caused by nematodes, a class of worm that includes such well known members as roundworms, trichina, pinworms, etc. Some species of nematode attack the aboveground parts of the plants, but all forms are soil inhabiting at certain times of the year, and get in their nefarious work by attacking the roots. They are very destructive under certain conditions. The sugar beet nematode, as an example, has been known to destroy the entire yield of a large crop area. One of the most important responsibilities with which Shell agricultural laboratory is charged is the development of nematicides in sufficient variety, and of sufficient strength to cope with widespread and various infections. The program involves among other things, the injection of likely compounds into infected soil, and the subsequent observation of effects over an appropriate period. Most of the preliminary injections are carried out in the greenhouses, but as they seem to merit further attention, are later applied on a large scale on outside plots.

The department of horticulture is given to the development of bigger and better crops, through the use of nutritives, stimulators, soil enrichers, etc. It also seeks to establish more economical processes of growing generally, particularly by minimizing cultivation; inhibiting the growth of weeds with sprays that have no deleterious effect on plants; regulating the maturing period of plants so as to bring them to market at the most desirable time; developing seedless fruits and vegetables; controlling size, flavor, and general appearance of fruits and vegetables, and either making them resistant to frost, or delaying blossoming beyond the season of frost. These are just a few of the problems with which the horticulturalist is faced, and it doesn't take too much thinking to realize that many other incidentals and contingencies are simultaneously involved.

Engineering, also, has an important place in the scheme of things. If it is pertinent to develop effective agents and reagents for the diverse purposes of the agriculturalist, it is equally pertinent to develop the right kind of equipment to make adequate applications. This department, thus, not only tests the devices manufactured and offered by the

Russians report hole 20 miles deep

Soviet geophysicists have drilled a hole 20 miles into the earth with an electric drill, the Moscow radio said November 5, according to an Associated Press report.

"The successful experiments near Leningrad show that electric drilling down to 30 or 40 kilometers (19 to 25 miles) can be achieved in two days," the radio said. "Until now, if it were at all possible, this would have taken several years."

This would be the deepest drilling on record. The report fails to give the diameter of the hole or the purpose of the project.

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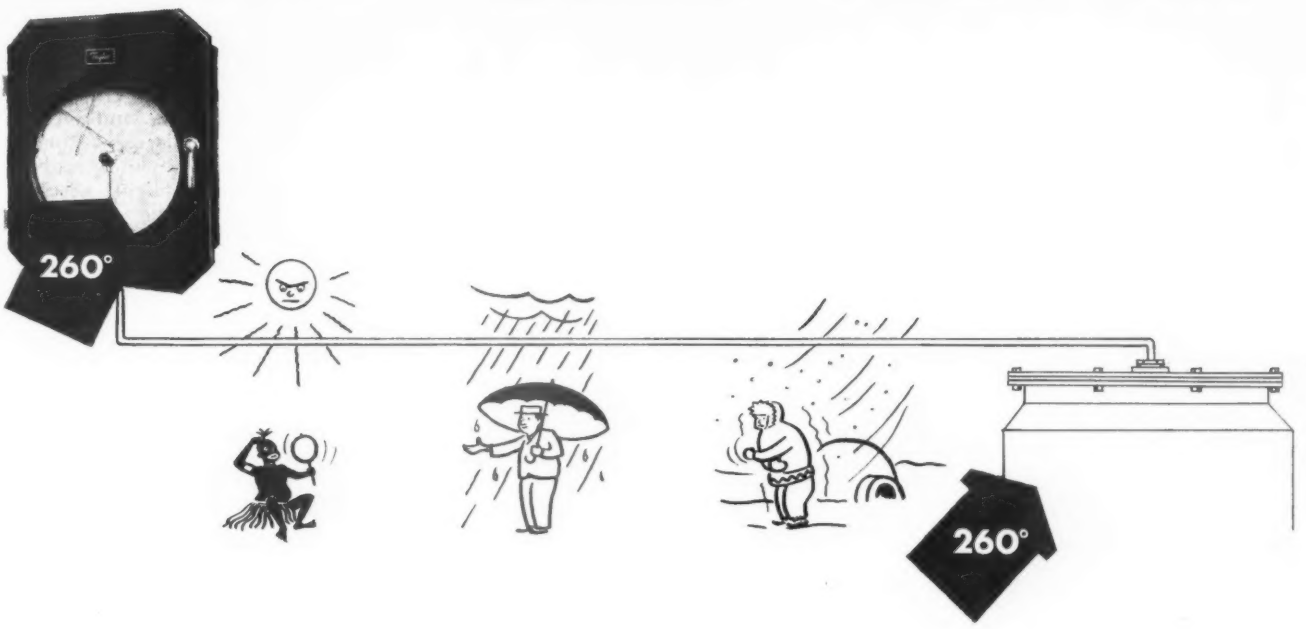

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Top—**Large lath house used largely as a holding place for plants between propagation in the greenhouse and transplanting in the fields.**

Center—**One of the large greenhouses in use at the laboratory with Mason Turner, technical assistant, in foreground observing weed control test.**

Nitrogen is fed to the plants in the form of ammonia, which is released into the irrigation ditches from cylinders as shown in the bottom photo.

regular equipment designers, for these and other uses, but will in addition design and construct new instruments and devices as the need is indicated, and will further improve existing apparatus as seems expedient. The wide scope of the agricultural industry opens an interesting field for engineering enterprise and adventure.

The plant physiologist is very much like the medical physiologist, in that his principal concern is the health of the plant—the functioning of its life processes, and the effects on these of the fungicides, insecticides, sprays, dusts, fumigants, herbicides, hormones, and other substances used to protect the plants from their natural enemies, or to excite them into specific behaviors. Plants, like humans, differ in their responses to stimulants, and are variously affected by the same treatment. It is the function of the plant physiologist to diagnose these differences, and to establish their causes. In this responsibility, obviously, he must work closely with all other departments, and of necessity must have a voice in the approval or disapproval of almost every substance or method that contributes to plant growth, or less directly to crop conservation.

The plant pathologist is also analogous to his medical prototype, for his immediate interest is the cure of plant diseases. It is his function to test new organic fungicides for control of disease; soil fumigants for the control of soil-borne pathogenic fungi, and, when a chemical shows promise in the laboratory or greenhouse, to conduct large scale experiments to determine its practical and economical worth under normal farming conditions. In this field there is much opportunity for research, for there are at present many diseases for which no cures are yet known. These present problems require the special talents of both the entomologist and the plant pathologist. Shell laboratory is now engaged in a project aimed at the control of insect vectors with new organic chemicals, so that the spread can be reduced. This type of work is of special interest to certified seed potato growers, for example, who must maintain a low rate of virus disease in feed stock.

It seems very apparent in a setup of this kind that there is not only a multi-departmental interest and activity in practically every agricultural problem that springs up, but there is a similar conjunction of interest with respect to the agricultural and petroleum industries. There can be no mistaking their relationship. It has grown into an indissoluble partnership. Petroleum is a ubiquitous substance that lends itself in many remarkable ways to the enhancement of life on this old planet. It is yet due to be exploited in industrial roles of which we little dream at the moment. But it is difficult to conceive of any purpose to which it could be more usefully applied, and with greater benefit to humanity at large, than the advance of agriculture in all its phases. ★★★

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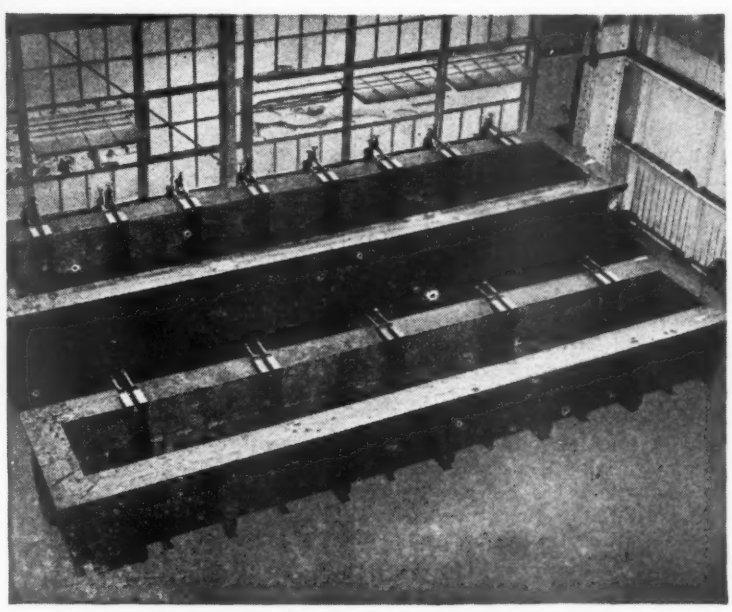

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By **K. MARSHALL FAGIN,** *Field Editor*

EXCLUSIVE

With its first well in the open Gulf of Mexico drilling below 9508 ft., Magnolia Petroleum Company has released its story of the first history making attempt to extend the chain or belt of prolific Louisiana Gulf Coast oil fields into the relatively shallow waters of the wide continental shelf that reaches 20 to 40 miles offshore. Although marine drilling operations are not new to the oil industry, especially the Gulf Coast area, this well, Magnolia Petroleum Company's No. 1 Louisiana Gulf Block 58, is the first one to be drilled so far out in the hurricane swept waters of the open Gulf of Mexico, and marks a pioneer effort of man to conquer nature in the endless search for new oil-producing areas.

● **Construction work under way on second platform—30 miles from land.** This first well is situated on a platform built in 16 ft. of water about 10 miles South of the Eugene Island lighthouse (see map), and 5 miles from Point Au Fer, the nearest land. Preparations for construction of a platform in 22 ft. of water for a second well, Louisiana Gulf Block 94 No. 1, situated about 25 miles farther out in the Gulf, are already under way, and the exploratory operations are progressing on schedule, according to J. L. Latimer, president of Magnolia.

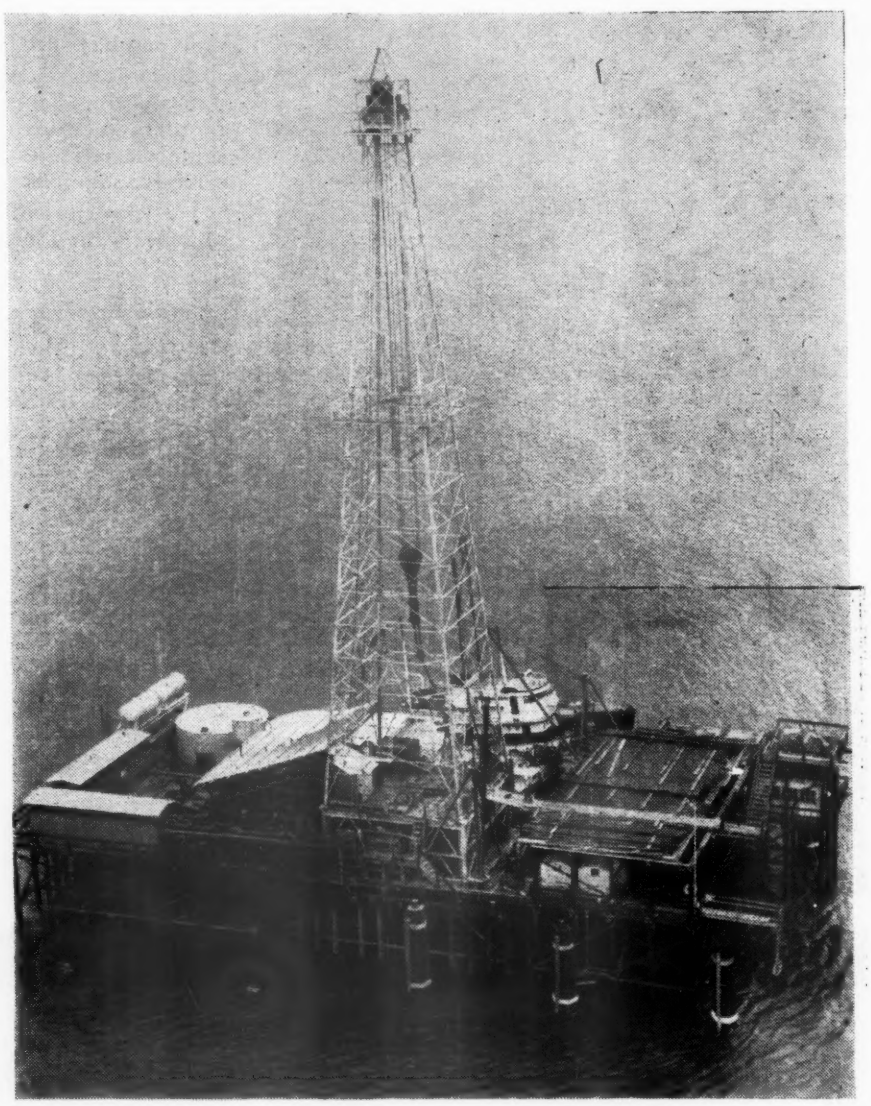
● **Magnolia's off-shore drilling blocks situated southwest of New Orleans.** The area being explored is about 75 miles West of New Orleans, and the first well is about 37 miles South of Morgan City where Magnolia maintains its shore base. Preliminary seismic exploration of the undersea area was conducted with a number of small boats obtained from the shrimp industry's fleet that anchors at Morgan City or across the Atchafalaya River at Berwick. The original seismograph crew, which has carried on this work for the past two years under the direction of Henry Cortes, Paul Nash, and Jack Lester of Magnolia's geophysical department, is now analyzing the balance of the undersea properties held by the company in this area.

● **Other off-shore drilling blocks being taken.** Widespread interest has been shown by the members of the petroleum industry and others who have heard about this hazardous and expensive exploration and development work, are involved in solving the many new and complex problems that arise in carrying out the undersea drilling program

● **Some work delayed by bad weather and darkness.** The weather provided the biggest obstacle to reckon with in the initial stages of operations. Surveying crews in boats could not perform their tasks for many days at a time, because of high waves, tides, river currents, ground swells, or stormy weather.

The pile driving barges were likewise limited to operation on fairly quiet days. Magnolia was both careful and fortunate to complete all the open-water work that has been done so far without any losses of men or equipment to hurricanes or other Gulf Coast weather disturbances that might have greatly delayed the program. All work prior to drilling was done only during the daylight hours.

● **Preliminary preparations took time and planning.** Lengthy preparations were required at the shore base at Berwick before Harry Allsman and J. Ray McDermott, the joint contractors of Harvey, Louisiana, were able to begin construction of the drilling platform shown in the accompanying pictures and figures. Magnolia purchased, leased, and



Magnolia Petroleum Company's first Gulf of Mexico well platform as seen from the air.

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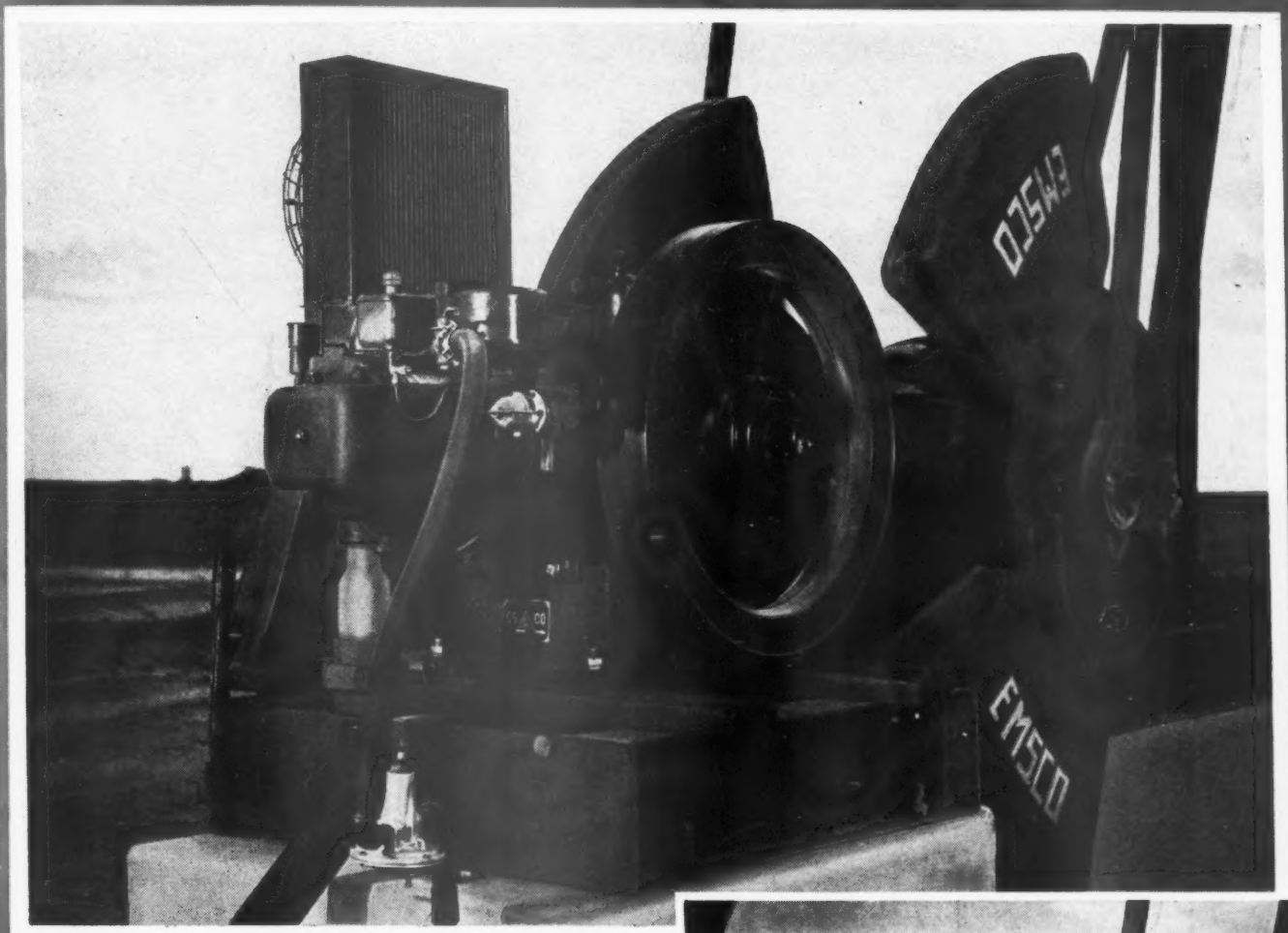

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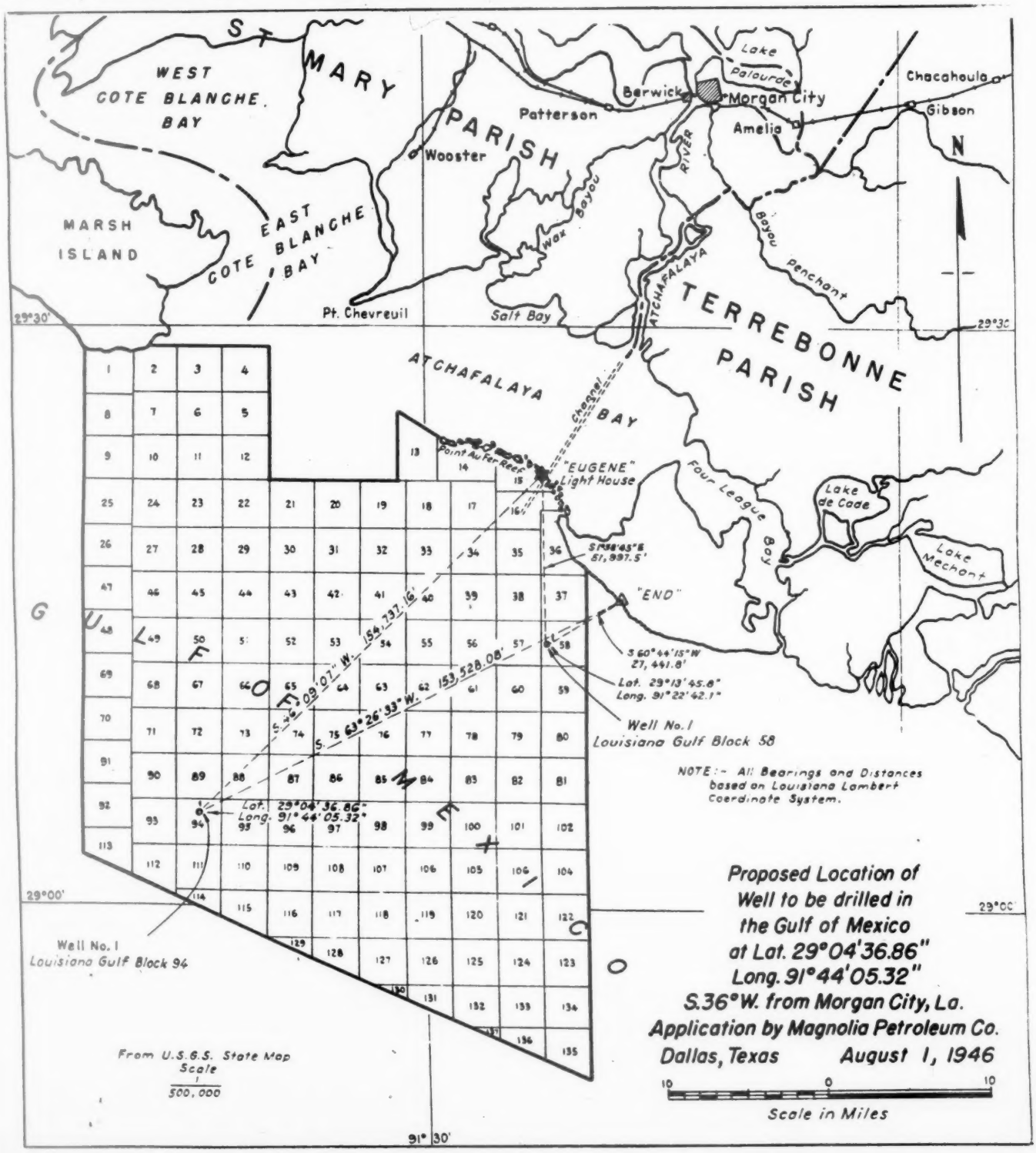
built several motor ships and smaller craft for transportation of personnel, supplies, and equipment for use in the surveying, geophysical, and drilling operations now under way. Two of the new 65-ft. motor ships were named for former managers of Magnolia's producing division, F. V. Faulkner and M. J. McLaughlin. These are comfortable, fast, cabin launches designed primarily for carrying personnel.

A maze of delicate seismograph instruments, surveying equipment, and supplies had to be installed and stored in the geophysical party boats. The work of making this kind of a survey in open water called for the construction of special markers, buoys, anchoring devices, and electrical equipment to withstand the corrosiveness of the salt air and the rolling of the waves. A great deal of ingenuity and skill on the part of the personnel and boat pilots was also required to coordinate the movement of the survey boats. It is not as easy a task to mark shot points, section corners, and well locations on the waters of the Gulf of Mexico as on the land it borders.

● **Living quarters provided 10 miles from first well.** A large house boat was purchased, remodeled, and rigged to serve as living quarters for workmen and crews that were to build the drilling platform and carry on the drilling program in this area. This quarter boat was named "The Magnolia Inn" and is complete with sleeping quarters, galley, dining room, club rooms, showers, radios,

FIG. 1. Map of the Louisiana off-shore drilling blocks in the area Southwest of New Orleans being explored by Magnolia Petroleum Company showing the location of the first drilling well, No. 1 Louisiana Gulf Block 58, and the location selected for the second well, No. 1 Louisiana Gulf Block 94.



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(King) — PCG-1879 Natural Gas — Butane — Propane Engine (Convertible to Diesel)
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(10 spot) — PC-1879 Natural Gas — Butane — Propane Engine.

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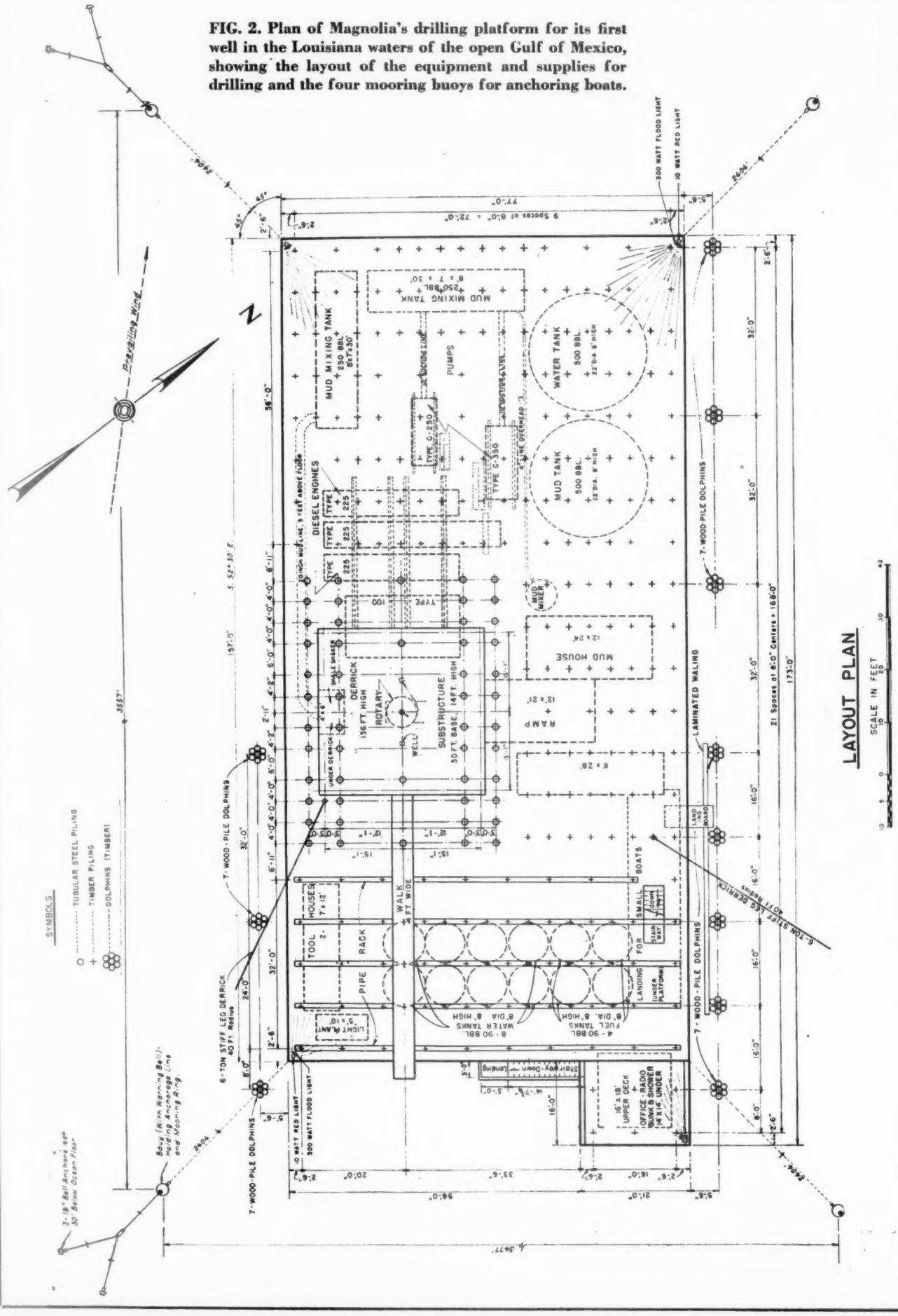
FIG. 2. Plan of Magnolia's drilling platform for its first well in the Louisiana waters of the open Gulf of Mexico, showing the layout of the equipment and supplies for drilling and the four mooring buoys for anchoring boats.



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About a "Cardwell" Double Drum Combination Drilling Rig. Now Available with Three Drums

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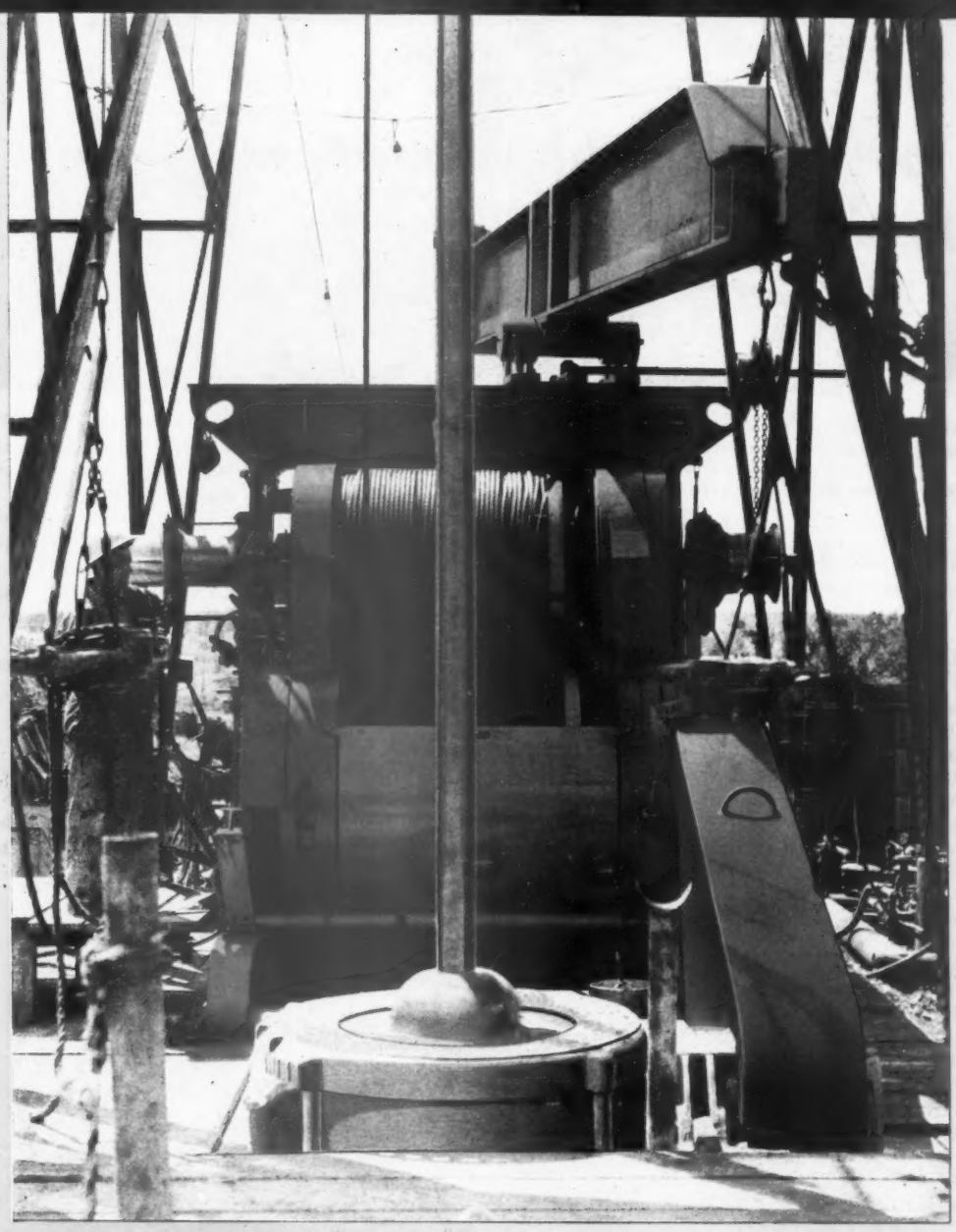
s rig can be ed for drilling m grass roots bottom with her rotary or le tools.



Ideal for drilling in, pumping potentials, well servicing and rotary workover jobs.

A real profit maker because this versatile rig can be kept busy on rotary, cable tool or servicing jobs.

This Model R combination rig can be used for drilling to 5,000 feet with 4½" drill pipe, cable tool drilling to 7,500 feet, and servicing or rotary workover to 10,000 feet. If desired, a spudding assembly can be had in place of beam. Spudder is interchangeable in the field with rotary assembly.

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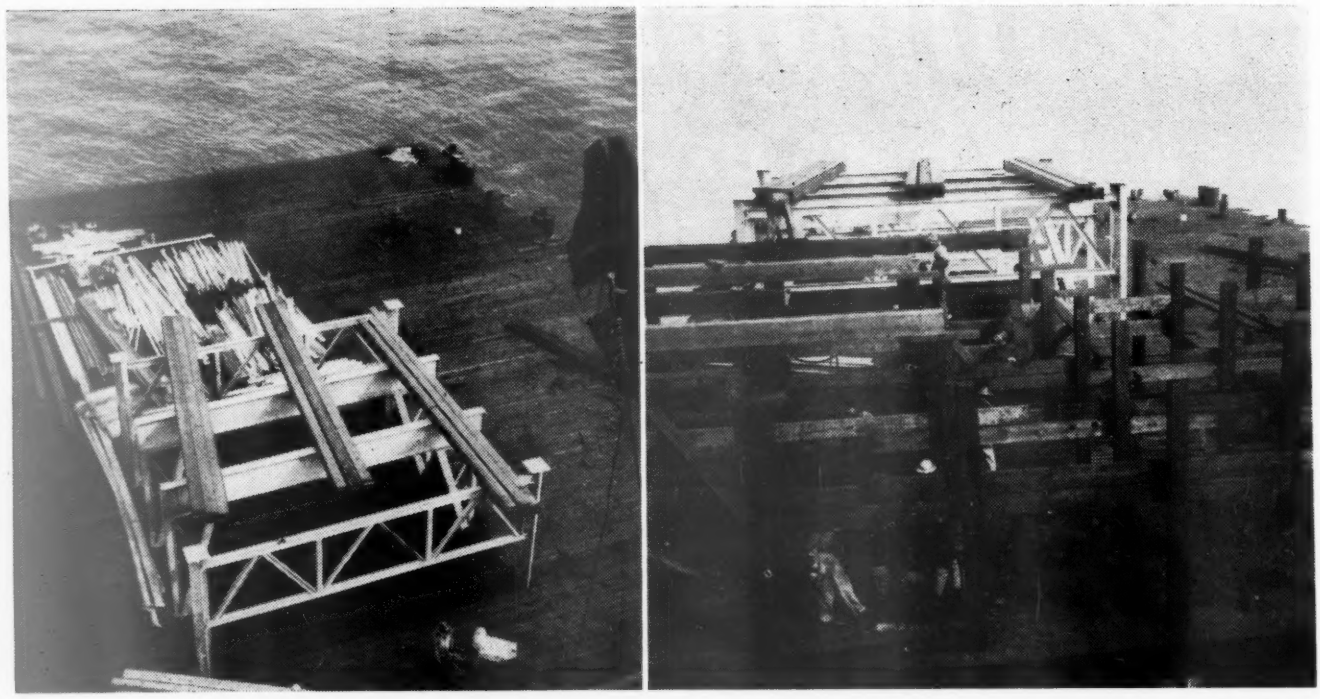

Left—**Steel structure for derrick is fastened to a skid beam assembly that can be skidded 6 ft. either way to drill two additional wells from the platform.** *Right*—**Creosoted timber columns of the casing and pipe racks are fastened by clip angles to the timber caps on the timber piling.**

and other conveniences of a hotel at sea.

A wharf and anchorage site was constructed for the quarter boat at Eugene Island near the U. S. Coast Guard lighthouse, which is about 27 miles south of Morgan City and 10 miles north of the first drilling platform.

● **Ship to shore radio communication.** A radio station aboard the quarter boat maintains constant communication with the drilling platform, the office in Morgan City, two automobiles, and the boats engaged in the surveying, marine construction, and drilling operations, and by a combination of radio and land lines, communication can be established between Magnolia's Dallas office and the drilling rig on the platform.

In addition to the above channels of communication, the seismograph crews have a separate radio system between crew boats and offices in Morgan City.

● **Radio systems save time and increase efficiency.** The communication systems enable Magnolia officials and employes to keep closely informed of the progress and problems connected with this new enterprise, and will greatly facilitate the handling of any emergency matters that might arise.

Magnolia's off-shore drilling program is under the general direction of E. D. Smith, manager, and A. E. Chester, assistant manager, of Magnolia's producing division. M. V. C. Bradley, general production superintendent; John Goodrich, division superintendent; Albert Shaw, drilling superintendent, and W. B. Powers, district superintendent, have been following and supervising the progress of the drilling operations.

● **A large number of people employed.** A drilling crew of 25 men under the direction of I. L. Ault, drilling tools foreman, is employed on the first well. It is interesting to note that one man is required ashore or afloat for every man on the crew. C. M. Rhodes, marine foreman, is in charge of the boats and boat personnel that shuttle the drilling crews and supplies to and from the drilling platform, and the radio technicians, cooks, and others who take care of the quarter boat.

Barges and tugs are engaged when necessary to move heavy supplies or equipment to the rig. More than 500 bbl. of fresh water has had to be hauled from shore to the well every day for use in the drilling mud, inasmuch as a brackish water well completed at the rig produced an inadequate amount.

The collection of samples, running of electric logs, coring, and other geological work is being done under the general direction of W. W. Clawson, chief geologist, P. H. Jennings, A. L. Mor-

One of the fast 65-ft. motor ships for carrying personnel and light supplies, the F. V. Faulkner, is tied to a tug that brought a barge with drilling supplies from the shore base.

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2-way Blade. Note Locating Hole.
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row, and W. R. Canada of Magnolia's geological department.

● **Construction of platform begun in May, 1946.** Although preliminary investigations and design of the first drilling platform were begun in September, 1945, actual construction work at the well site was not begun until May 28, by driving of piles for a temporary working platform near the location, which was "staked" with a buoy.

The design and construction of the platform was under the general supervision of E. E. Holstein, chief civil engineer, and R. G. Watts, assistant chief civil engineer. Ben C. Johnson and W. L. Montgomery of Magnolia's civil engineering department were in direct charge of the platform design and construction, respectively.

● **Platform completed in 60 days.** The 173-ft. by 77-ft. drilling platform was completed in about 60 days. The floor level of the platform is 19 ft. above the water at high tide when the water depth is about 18 ft. The derrick floor is 13 ft. above the main deck.

A total of 338 wood pilings 110 ft. long was used in the foundation, and a total of 52 steel pilings 136 ft. long was used to support the derrick foundation.

A 136-ft. steel derrick was built on a 30-ft. by 30-ft. by 14½-ft. steel substructure, thus elevating the derrick crown blocks to a point 168 ft. above the water at high tide. As indicated by the drawings (Figs. 3 and 4), a 10-watt red light is used at night to mark the top of the derrick, about 180 ft. above the water.

● **Platform may be used for three wells.** The derrick foundation was designed with a heavy skid beam assembly under the substructure for the purpose of skidding the substructure and derrick forward or backward 6 ft. from the central position, in case two more wells are to be drilled directionally from the present location.

The derrick substructure was specially designed so that all derrick floor loads are carried by the corner and side col-

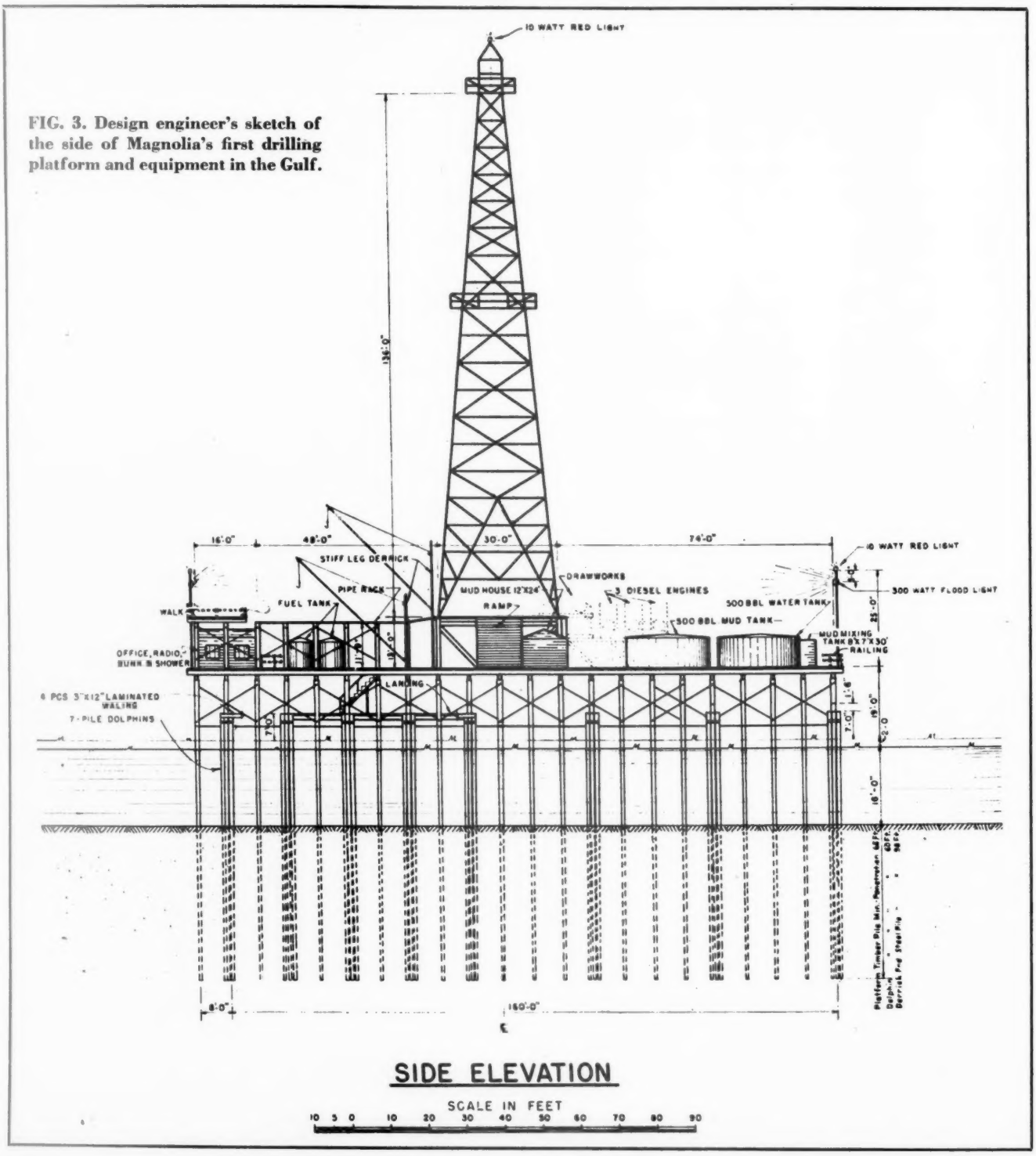


FIG. 3. Design engineer's sketch of the side of Magnolia's first drilling platform and equipment in the Gulf.

umns of the structure. The upper skid beam was fastened to the substructure, and the lower skid beam rests in a fixed position on the steel wide flange beam caps of the steel pile foundation. The upper and lower skid beam assembly is made up of six 10-in. wide flange beams weighing 89 lb. per ft.

● **Platform designed to withstand 150-mile hurricane.** The main deck of the platform was designed to support a live load of 500 lb. per sq. ft. except under heavy equipment concentrations where the platform was designed to carry 1300 lb. per sq. ft. The lateral stability of the drilling foundation and derrick foundation was designed to withstand a 150 mile per hr. hurricane and the resulting wave action. Maximum wave height above water level was estimated to be 18 ft. The derrick used was designed to withstand a 125 mile per hr. hurricane wind.

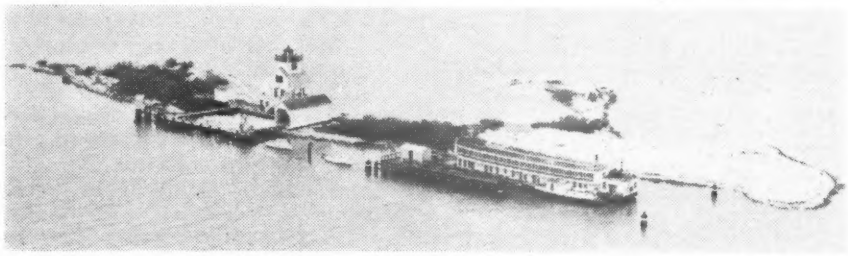
The steel pile foundation was designed and arranged so as to carry the load of the derrick and substructure, which amounts to 1,400,000 lb. total for the corner columns. Of this total amount, 450,000 lb. for the casing and 200,000 lb. for the drill pipe set-back is transferred to the side columns. The weight of the derrick and substructure amounts to 91,000 lb. and is not included in the above loads. The timber platform deck was designed for 2,250,000 lb. live load.

● **Piles driven 70 to 100 ft.** The 110-ft. fir piles dropped of their own weight into the top 20 ft. of the ocean bed, which is very soft at the well site, and were driven with 320 to 340 pile drive blows into stiff gumbo with a penetration of about 70 ft. The 136-ft. 15-in. O.D. steel piles having a wall thickness of 1-in. were driven to a penetration of 100 ft.

The steel piles were constructed of surplus steel tubing left over from the manufacture of bomb cases during the war. The joints of tubing were welded together into 136-ft. lengths before they were transported by barge to the location. Each weld was reinforced by welding four steel straps across the joint.

The timber piles were designed for a maximum live load of 30,000 lb., and were given a 14-lb. creosote treatment. The steel piles were designed for a maximum load of 50,000 lb.

Test coupons from the steel piling were tested to an ultimate tensile strength of 119,000 lb. per sq. in. Test coupons cut to determine the strength and quality of the welds on the steel piling showed an ultimate tensile strength of 96,000 lb. per sq. in. This was due to



***Above*—Eugene Island is a man-made island used for many years as a lighthouse. Magnolia's quarter boat is moored to pilings between the island and a wharf used as a way station for drilling well equipment. *Below*—The "Magnolia Inn" quarter boat is moored to pilings at Eugene Island.**

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the high carbon content of the steel piling. X-ray examination was also made of each weld.

● **Foundation bracing is 3½ ft. above high water.** The timber piling is braced horizontally and diagonally with 5-in. by 5-in. by ⅜-in. angle bracing, beginning 3½ ft. above mean high water. The steel piling is braced with 8⅛-in. O. D. 39.5-lb. casing welded at the points of connection. All the pipe braces were cut and welded by the welding crew that cut the steel piles to the designed level at the well. The crew completed its work on the foundation in two weeks time.

The timber piling was trimmed about 3 ft. to the designed level and treated with hot tar and roofing paper before the ⅜-in. galvanized steel hoods were bolted in place. Timber caps are fastened effectively to the timber piling by the use of these metal hoods, thus increasing the rigidity of the foundation structure.

A 40-ft. by 75-ft. pipe and casing rack is supported on 8-in. by 8-in. timber columns 12 ft. 9 in. above the main deck. These timber columns are fastened by clip angles directly to the caps on the timber piling.

Eleven mooring or bumper clusters (dolphins) are arranged around the platform. Each of these is constructed of seven 90-ft. creosoted fir piles lashed together with galvanized wire rope. They serve to protect the platform foundation and as moorings for boats.

The main deck of the platform is floored with 3-in. by 12-in. planks laid across 3-in. by 12-in. stringers on 12-in. and 18-in. centers. The stringers are laid across 12-in. by 12-in. timber caps that are fastened to the piling.

● **Summary of materials used in platform.** Materials used in the construction of the platform include: 261 creosoted fir piles 110 ft. long, 77 creosoted fir piles 90 ft. long, 73,400 bd. ft. of creosoted lumber, 52 steel piles 15 in. O.D. by 136 ft. long, 80,000 lb. of wide flange beam caps and skid beams, 32,000 of 8⅛-in. O.D. tubular bracing, 20,200 lb. of steel angle iron bracing, 26,400 lb. of connection angles and metal hoods for timber piling, 29,000 lb. of bolts, nails, washers, and miscellaneous hardware.

Caps for the steel piles are 17-in. by 1½-in. base plates welded to the top of each pile and joined by welding to the 10-in. 89-lb. wide flange beam caps that rest upon them.

The platform foundation was completed and ready for rigging up rotary drilling equipment by August 7, 1946. This equipment began to arrive at the platform by barge the next day. Rigging up was completed and the well was spudded in on August 23.

A 30-in. O.D. steel conductor pipe was driven to a depth of 150-ft. below the derrick floor before the well was spudded in with a rotary bit. This pipe was rolled and butt-welded from tank plate steel in 50-ft. lengths at one of Magnolia's field machine shops. The joints were welded together above the derrick floor as the pipe was driven.

● **Arrangement of drilling equipment.** The accompanying sketches, Figs. 2, 3, and 4, illustrate the arrangement of the drilling equipment on the platform and the engineering that was necessary to fit each item into the limited space and keep the load on the platform within safe limits at all times.

Notice that the landing for small boats is under the main deck and 7 ft. above low tide with a stairway connecting it to the main floor.

The main deck has space for the three large diesel drilling engines, two drilling mud pumps, a low 500-bbl. mud tank, a low 500-bbl. fresh water tank, two 8-ft. by 7-ft. by 30-ft. mud mixing tanks, a 12-ft. by 24-ft. drilling mud house, a 12-ft. by 21-ft. ramp, an 8-ft. by 28-ft. platform for a cementing truck, a large elevated pipe and casing rack with four 90-bbl. fuel oil tanks and eight 90-bbl. fresh water tanks underneath, a 5-ft. by 10- ft. light plant house, two 7-ft. by 12- ft. tool houses, two 6-ton stiff leg derricks with 40-ft. radius, and a 14-ft. by 14-ft. building on the corner for an office, radio, bunk, and shower house.

A 16-ft. by 18-ft. deck is built above the office to accommodate an electric logging, gun perforating, or other well servicing truck. This upper deck is on the casing rack level.

The platform is lighted at night by 300-watt flood lights fastened to 25-ft. poles set at each of the four outside corners. A 10-watt red marker light is fastened to the top of each of these poles.

Drilling mud flows from the well into a shale shaker, situated under the derrick floor, and on to a mud mixing tank through a 20-in. diam. pipe that is elevated about 5 ft. above the platform floor. The mud mixing tanks are covered to prevent dilution of the mud by rain. ★★★

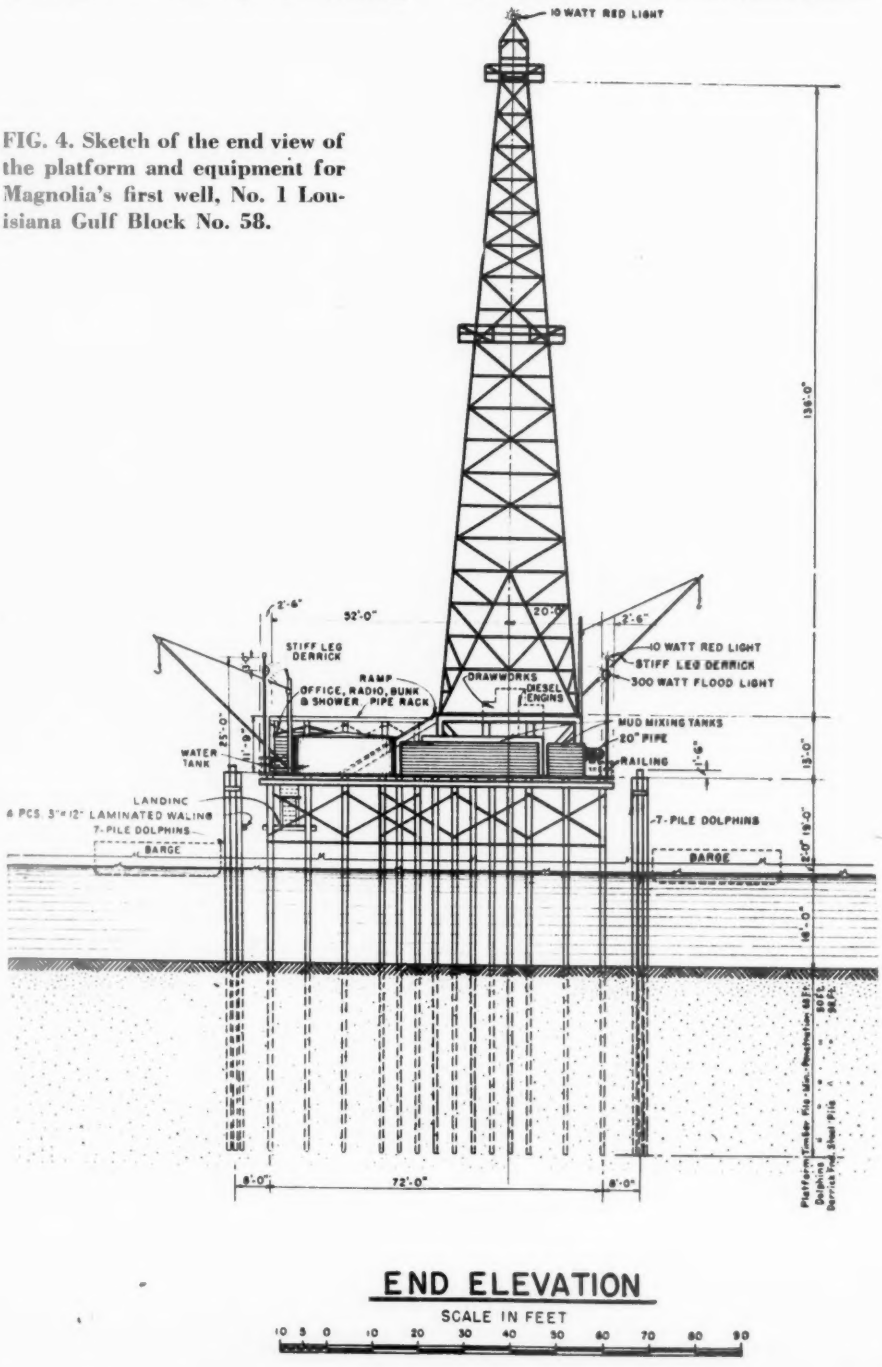

FIG. 4. Sketch of the end view of the platform and equipment for Magnolia's first well, No. 1 Louisiana Gulf Block No. 58.

END ELEVATION

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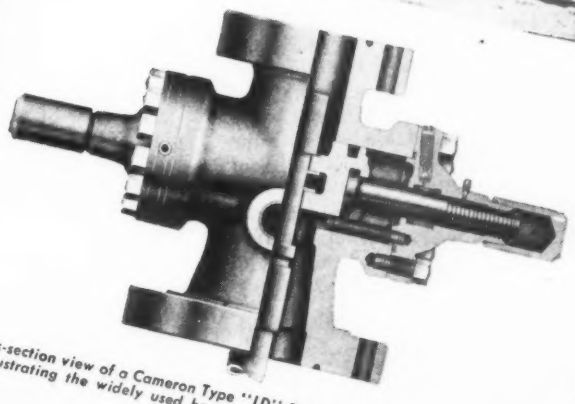

Cross-section view of a Cameron Type "LD" Ram Type Tubing Control Head, illustrating the widely used hanger nipple type suspension of tubing.

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Tank ventilation

By **O. W. JOHNSON**

Standard Oil Company of California

REMOVAL of residual vapor from any tank that has contained a volatile oil is an important step in conditioning the tank for entry for inspection, cleaning, or repairs. The process is commonly referred to as "gas freeing," although the essential element in the process is simply to reduce the vapor content of the tank atmosphere to some value that can be breathed without discomfort and without effect on the health of the worker.

Steam, flue gas, CO_2, or other similar "inert" gases are sometimes recommended for purging tanks, but in every case it is necessary that final ventilation with air be employed to provide an atmosphere that is safe for men to breathe.

The following discusses the application of both air and steam in purging tanks of residual vapor, bringing out important differences in behavior and results obtained. Mechanical problems in connection with the actual removal of solids and liquid tank residues are not covered.

● **Functions of steam in tank cleaning.** Steam introduced into a tank can assist in the cleaning process in several ways, such as displacing vapor, heating the shell, evaporating volatile residue and reducing the viscosity of heavy residue, and diluting explosive mixtures to render them noncombustible. All these functions are interrelated, and most depend for effectiveness on having an adequate supply of steam.

To serve as a displacing medium, steam must remain in the form of a gas, and the only practical way to accomplish this is to supply steam at such a rate that there will be a surplus over and above that which can condense on the tank roof and shell. In other words, the steam must be supplied fast enough to heat the whole tank close to the boiling point of water. This can often be easily accomplished when steaming drums or other small containers.

In attempting to apply this process to larger tanks it will usually be found that the supply of steam is inadequate to heat up the whole tank. In many cases equilibrium will be established, with the steam condensing on the walls and roof as fast as it enters. Only about a third of the vapor in a tank will be displaced by heating from atmospheric temperature up to 140°F. by the use of steam, and when equilibrium is reached displacement of vapor will cease.

The value of steam in evaporating volatile residue has been greatly overemphasized. The shell and roof of a tank can be readily heated by steam injected into a tank, but the amount of residue on the shell and roof supports is unimportant. Bottom residue will not be heated to a significant depth by this means even when steaming is continued for several days, and the process will have little effect on the quanity of vapor that may be liberated from a deep layer of sludge when it is stirred up in the process of removal. It might be mentioned in passing that the advisability of trying to drive off violatile constituents from bottom residue is open to serious question. The most effective method to accomplish this heating is to inject steam beneath the surface of the residue by means of a hand operated steam lance; however, it appears better in many cases to avoid heating bottom residue, thus decreasing the amount of vapor that the ventilating process is called upon to dissipate.

The viscosity of heavy residue can be reduced by heating with steam. The combined heating and washing action of condensing steam is useful in cleaning the walls of tank cars, drums, etc., which have contained heavy oils. The effect on heavy bottom residue is likely to be slight, unless a lance is used.

Steam can dilute an explosive mixture to render it noncombustible. A concentration of about 40 per cent of steam in the mixture will be required, equivalent to a temperature of 170°F. It is seldom that steam sufficient to attain such a temperature in a large tank will be available, and in most cases an equilibrium will be established at some lower temperature, as previously discussed in connection with vapor displacement. The result is that the tank may stand in an explosive condition for many hours. Visual evidence that steam is issuing from tank openings is not assurance that protection against explosive mixtures is being accomplished. Even where a tank can be ultimately heated to 170°F. the process is likely to require a considerable period of time.

A review of the above will show that most, if not all, of the functions of steam in tank cleaning are seriously limited unless steam can be supplied at a rate high enough to heat the tank to a minimum of 170°F. within a period of a very few hours. In practice it is found that large tanks are usually situated so far from steam sources as to preclude using steam effectively even if the boiler capacity were adequate to supply the required rate. The results of an inadequate steam supply are excessive delay, failure to achieve some of the important objectives, a prolonging of the period during which the tank may remain in the explosive range, a temptation to begin other work while the tank still contains explosive mixtures, and generally increased overall cost. In addition, injection of steam into a tank may be attended by a certain amount of hazard, because a steam jet is a strong generator of static electricity, and conditions may occasionally prevail in a tank that can permit the accumulation and discharge of a dangerous spark. There have been several cases of fires occurring during tank steaming operations.

● **Natural ventilation.** One of the simplest methods of dissipating vapors in a tank is to open top and bottom manholes and permit the tank to ventilate by natural means. Agencies that will promote natural ventilation include wind and the thermal effect of sunshine. If the tank initially contains rich vapor it is possible that the first tendency will be for vapors to flow from the lower manhole and air to enter at the top; however, as tank atmospheres contain only a small percentage of the heavy hydrocarbon vapor, it takes only a small temperature increase to make the tank vapors lighter than the surrounding air. In most cases, particularly where the sun shines, ventilation will soon reverse and air will enter at the bottom openings and tank vapors leave at the top.

Natural ventilation will be promoted by heating the tank by injecting steam. This is the chief effect of the common practice of "steaming with hatches open". Steam injected into a large tank has little effect on the explosibility of vapor space.

● **Explosive mixtures.** from the preceding discussion it will be clear that in ventilating any tank that initially contains a rich mixture the tank atmosphere will pass through the explosive range. This will be true whether natural ventilation alone is relied upon, or whether such ventilation is aided by heating the tank with steam. The only exception to this general rule will be those few cases where steam can be supplied in such quantity as to promptly heat the tank to steam temperature, so that the steam can serve as a displacing medium. Limitations in steam supply will prevent attaining this end when steaming large tanks except under rare circumstances.

The hazard attending the presence of an explosive mixture during some stage of the ventilating process will depend largely on the chance that a source of ignition could occur in the vicinity. Experience seems to indicate that this hazard can be controlled adequately.

By far the greatest proportion of potential sources of ignition are associated with the presence of men, hence safety will be found by arranging that no unnecessary work be done on or in the vicinity of the tank during the period when an ignitible mixture is present. In particular, it will be desirable to defer all work in connection with sludge removal until after the tank vapor space

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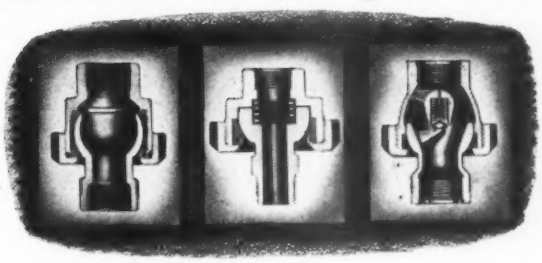

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has been brought well below the explosive range.

The hazard attending the injection of steam into the vapor space of a tank has already been mentioned. Although the combination of circumstances that can result in the production of dangerous sparks by this means does not occur frequently, several explosions in tanks that were being steamed are on record, and this potential source of ignition cannot be ignored.

All things considered, it is concluded that if the injection of steam into a tank is avoided, and if other work is deferred until the tank is safely out of the explosive range, the chance of an ignition during the transitory explosive period will be exceedingly small. This conclusion appears to be borne out by experience.

Control of the safety of tank cleaning operations implies a knowledge of conditions within the tank vapor space at all times, and the only practical way to insure this is to make periodic tests with a combustible gas indicator. By this means the progress of ventilation can be followed readily. Usually it will be desirable to allow ventilation to continue until readings of 1/10 or less of the lower explosive limit are obtained at the opening where the air leaves the tank. By this time it will be safe to enter the tank to make exploratory tests throughout the area. The reading should not be taken too close to the surface of the sludge, for it will be obvious that there may be a very shallow layer of richer vapor at that point if the sludge contains volatile material. This shallow layer is unimportant from the standpoint of the condition within the tank as a whole, hence it is customary to take samples at the level of a foot or more above the residues.

The presence of pyrophoric compounds is sometimes feared to be a potential source of ignition during tank ventilation. Experience seems to indicate that such compounds do not form in tanks in which the atmosphere normally contains a reasonable percentage of oxygen, as will be the case in all atmospheric pressure tanks not connected to vapor systems. Probably the only places where the presence of pyrophoric compounds is likely are fractionating towers and similar process vessels, and small tanks, where oxygen is excluded by the nature of the operation. The cleaning of such vessels presents special problems not related to ordinary tank cleaning.

● **Removal of residues.** It is always desirable to defer beginning the work of sludge removal until the tank vapor space is well below the lower explosive limit. This will avoid the possibility of an explosion in case the work of sludge removal should introduce an accidental source of ignition, and will also make it unnecessary to employ respiratory protection in cases where hydrocarbon vapors are the only foreign gases present.

The problem of sludge removal will not be greatly different whether steam or natural ventilation is used to effect the initial vapor displacement, because, as previously pointed out, the effect of steaming on the composition of bottom residues is likely to be unimportant.

It may happen frequently that attempts to remove sludge result in stirring up the residue with a release of additional vapor, so that the vapor concentration in the tank may build up to a dangerous extent. This will occur even though steam has been used previously. The only remedy for this situation is to defer further efforts at sludge removal until ventilation has had an opportunity to catch up with the situation. Where the rate of natural ventilation is low or the volume of gas released is great, the delay involved may be serious. This suggests the desirability of increasing the rate of air flow by mechanical means.

● **Mechanical ventilation.** Mechanical air ventilation offers two important advantages. In the first place, the total time required to bring the tank safely below the explosive range is greatly reduced. This promotes safety by decreasing the period during which ignition may occur, and may also have economic advantages. Second, the ventilation, continued during the cleaning process, may carry away the vapor released by stirring up tank bottoms as fast as it is evolved, permitting the work of sludge removal to proceed with little or no interruption.

Mechanical ventilation may be produced by several means, the most universally applicable being fans or blowers operated by engines or compressed air and injectors (or ejectors) operated with air or steam. The method chosen usually will depend on the size of the tank and the availability of steam or compressed air in the vicinity.

Portable blowers driven by gasoline are excellent for small tanks at isolated locations. Safety considerations will suggest that the engine be placed on the windward side of the tank and that 20 ft. or so of canvas duct be used to deliver the air to the tank. In such cases it is usual to admit the air to the tank through a bottom opening.

Where steam or air is already piped to the vicinity of the tank, the simplest and best method of tank ventilation is to use an ejector mounted on a top opening. Steam or air may be supplied to the ejector either through hose or temporary piping. The advantages of exhausting vapors from a top opening are that all bottom manholes can be open to admit air and later afford unimpeded access for sludge removal, and that the vapors are discharged where there is little chance of reaching a source of ignition. The fact that the tank vapors may initially be slightly heavier than air offers no obstacle.

An ordinary steam supply is ample to provide good ventilation when used as the motive power for an ejector but will have little effect if injected directly into the tank.

Where steam or air is not piped to the area, a portable air compressor will serve. Air or steam turbine operated blowers are also suitable, although the first cost is usually greater.

The value of large air volumes in tank ventilation may be readily appreciated when it is realized that a 20-in. eductor will handle 5000 cu. ft. per min. of vapor, sufficient to completely displace a 100,000-bbl. tank in less than 2 hr. With mechanical ventilation at this rate (or at proportionately lesser rates for smaller tanks) it will usually be possible to carry away the vapor that evaporates from the volatile bottom residues without having an explosive mixture in any point in the tank except very close to the surface of the sludge. As previously mentioned, such thin layers of rich mixture are of little importance from the standpoint of explosion hazard or toxicity.

● **Summary.** 1. With the steam supplies commonly available, injection of steam into the vapor space of a tank is unable (except for very small tanks) to displace any large proportion of the vapor present, or to sufficiently dilute initially rich or explosive mixtures so that they will no longer be ignitible.

2. Steam injected into a tank will not drive appreciable amounts of volatile constituents out of bottom residues, and the effect of heating shell residues will be unimportant.

3. Steam injected into a tank will assist in promoting natural ventilation, but the same quantity of steam will produce vastly greater results if used as motive power for some sort of air mover, such as an ejector.

4. Steam injected into a tank introduces an ignition hazard by generation of static electricity.

5. Transitory explosive mixtures will usually prevail in tanks during the ventilation process, both when air alone is used and when steam is injected into the tank; however, by employing forced ventilation with air the period during which the explosive condition prevails can be greatly reduced.

6. Safety will be promoted by deferring sludge removal and all other activities requiring the presence of men in the vicinity until the tank is safe from explosion. Frequent tests with a combustible gas indicator will be desirable.

7. Under most conditions, tank purging by forced ventilation with air can be accomplished with less hazard than where steam is injected into the tank.

★★★

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Oil men should brand their machinery and equipment to prevent loss by theft, just as cattle owners brand their herds. The proposal was made by Paul Pitzer, head of the theft prevention committee of the Texas Mid-Continent Oil and Gas Association.

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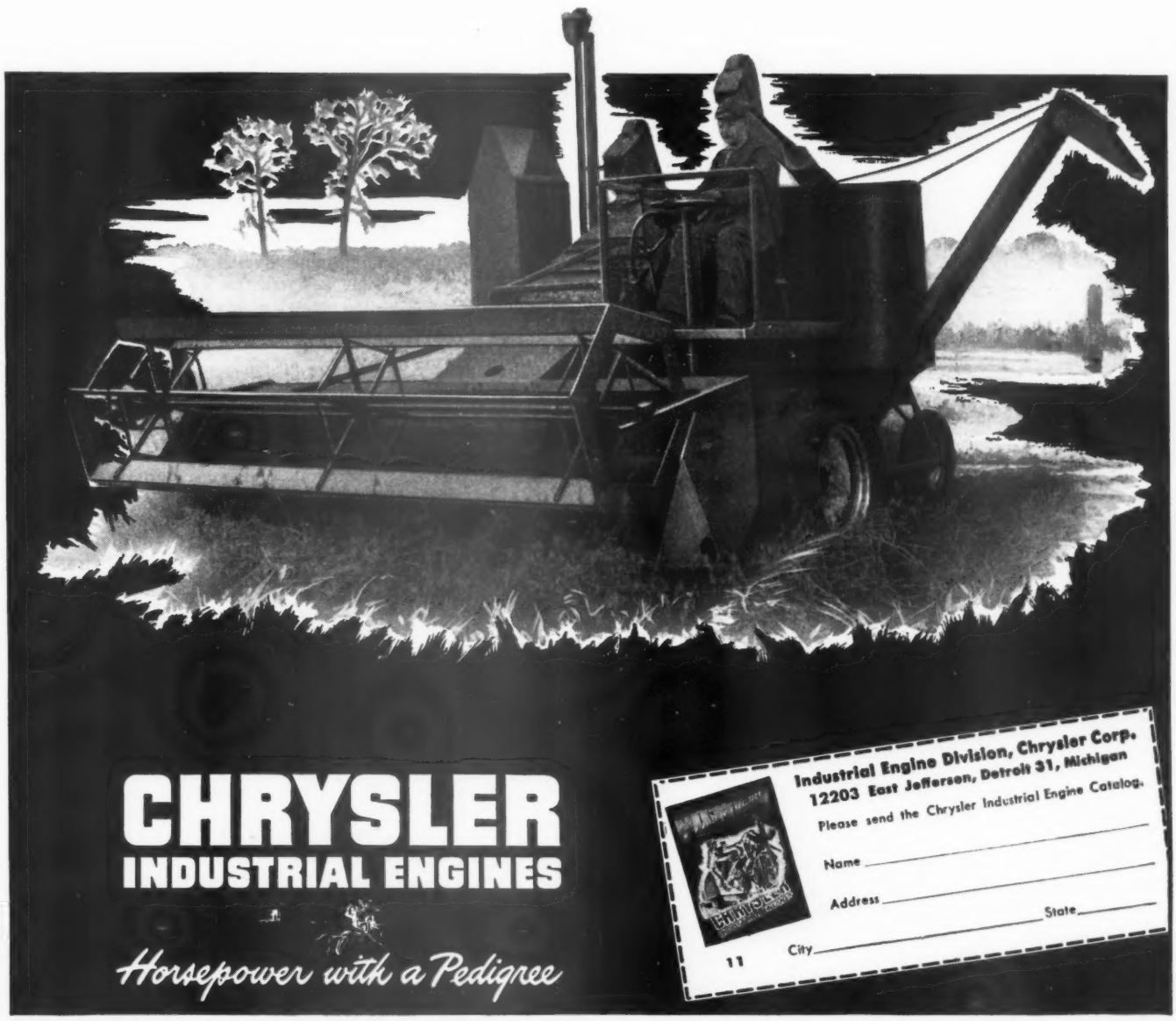

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Texas gas for California*

By **A. F. BRIDGE,** *Vice President and General Manager*
Southern Counties Gas Company of California

PART 1

A 1200-mile pipe line, to transport 300,000,000 cu. ft. of gas daily from Texas to Southern California, is a project that has provoked many questions, particularly relative to the need for such a costly undertaking, in view of the known large reserves of gas in California. I can assure you that the decision to build this line was reached only after much study and analysis, and some unavoidable crystal-gazing. It involved the resolving of many economic and engineering problems, and the job of building it is yet to be done. In the limited time allotted, I shall attempt to outline for you the background of this line, its justification, what it is expected to accomplish, and shall touch briefly upon certain engineering features.

● **What is the need for a Mid-Continental supply?** Some sections of Southern California have enjoyed natural gas service since 1907, and virtually the entire area since 1927. Throughout this period until quite recently, the rate of production of oil-well gas has sufficed to meet the rapidly growing requirements of domestic and commercial customers in this territory, and to provide a comfortable margin of supply, which was sold to industry on an interruptible basis. In fact, this industrial market was developed to provide a means of absorbing residue gas that would otherwise have wasted, since such gas is a by-product of crude oil production and hence its rate of availability is dependent on the varying demands for petroleum rather than for gas.

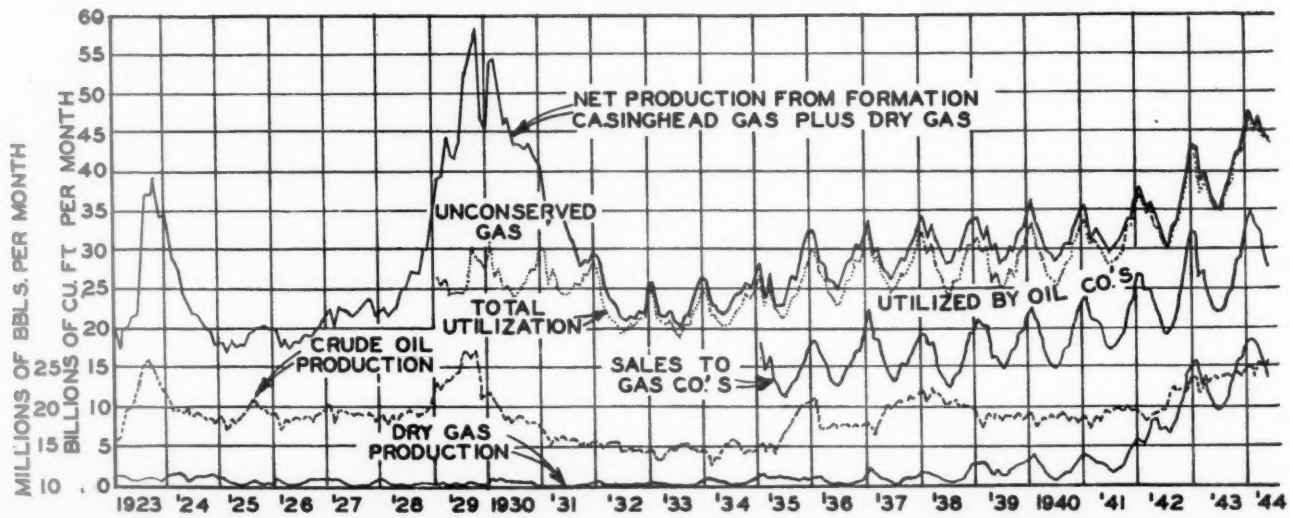
Fig. 1 shows this history clearly. This shows total natural gas production and utilization in California for the period 1923 to 1939, inclusive. Note the excessive waste that accompanied the so-called town-lot development in Los Angeles Basin fields in 1923, and again in 1929-30, which overlapped flush period overproduction in Kettleman Hills. This latter situation was somewhat relieved by new markets provided by construction of P. G. & E.'s Bay line in 1929, and the Southern Fuel line to Long Beach in 1931. Wastage, which reached an average of 232,000,000 cu. ft. per day, equal to 42 per cent of production in 1930, has declined to only 39,000,000 cu. ft. per day, or 2.6 per cent, in 1945, as shown in Fig. 2. This downward trend in gas waste is evidence of an increasing awareness on the part of the oil industry of the value of gas, not merely as a marketable by-product, but also as an essential means of increasing the ultimate recovery of oil from the common reservoir.

Throughout the entire history of natural gas service in Southern California we have been dependent on residue oil-well gas to an extent not generally realized. Thus, in 1945, approximately 97 per cent of our total supply was obtained from such sources. In California, oil-well gas is universally sold to the gas industry on a so-called "surplus" basis, involving retention by the producer of (1) complete control over rate of production, and (2) prior rights to use all gas produced, for hydrocarbon recovery, field fuel, and reinjection into the formation for pressure maintenance. So long as the net or residual rate of production of oil-well gas, after satisfying these underlying requirements of the producers, was substantially in excess of the demands of our firm customers, everything was rosy, but during the early war years a rather abrupt decline in our supply margin occurred, due chiefly to the adoption of pressure maintenance in oil production on a major and progressively increasing scale. Referring to Fig. 2, which shows California oil-well gas production and disposition for the period 1935 to date, observe that prior to 1941 the volume of gas used for this purpose was insignificant, but thereafter it mounted rapidly, and has now reached a figure of 300,000,000 cu. ft. per day, or about 25 per cent of gross production. Obviously this change in oil production methods, which is vitally necessary as a means of conserving our petroleum resources, does not deprive our customers of this gas forever, but merely removes it from the market until the pressure maintenance cycle is completed—possibly 15 to 20 years hence. In the meanwhile, however, a serious gas deficiency may develop. This trend serves to emphasize the point, of which the gas man is painfully aware and which the public rarely understands, that even if our gas reserves were sufficient to last 100 years, which they are not, we still shall be acutely short in the immediate future, when the rate of availability of residue gas fails to equal firm load requirements.

In the summer of 1943, as the ultimate effect of this progressive diversion of oil-well gas to reinjection became increasingly apparent, we undertook a compre-

*Presented before the annual convention of the Pacific Coast Gas Association, San Francisco, California, September, 1946.

FIG. 1. California crude oil production and natural gas production and utilization.


MILLIONS OF BBLS. PER MONTH
BILLIONS OF CU. FT PER MONTH
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UNCONSERVED GAS
TOTAL UTILIZATION
UTILIZED BY OIL CO.'S
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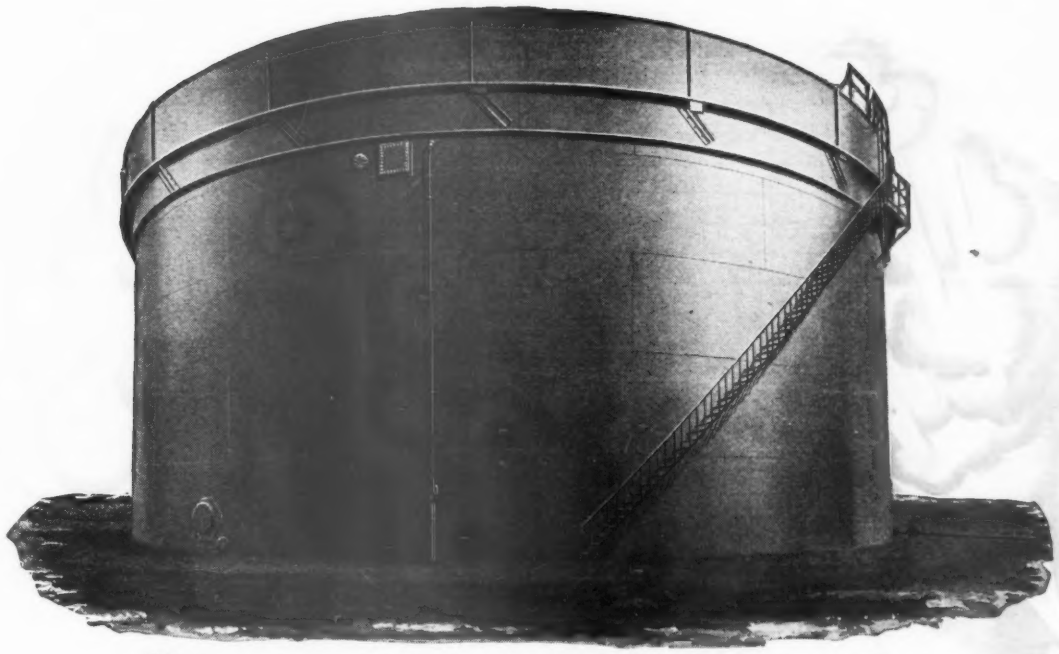
1923 '24 '25 '26 '27 '28 '29 1930 '31 '32 '33 '34 '35 '36 '37 '38 '39 1940 '41 '42 '43 '44



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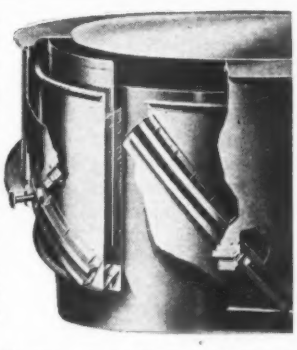

The simple mechanism, which directs and stabilizes the upward and downward movement of the roof, consists of nothing but a track placed at regular intervals at an angle of 45 degrees; a roller guide rides in this track and other roller guides, placed at 90 degrees to the rollers in the tracks, ride against the side of the tank and take any lateral load such as from high winds. The bearings of the roller guides are self-lubricating to minimize maintenance and repair. This simple stabilizing mechanism prevents binding of the tank roof even under conditions of unequal loads caused by snow, ice, settled tank foundations, etc.

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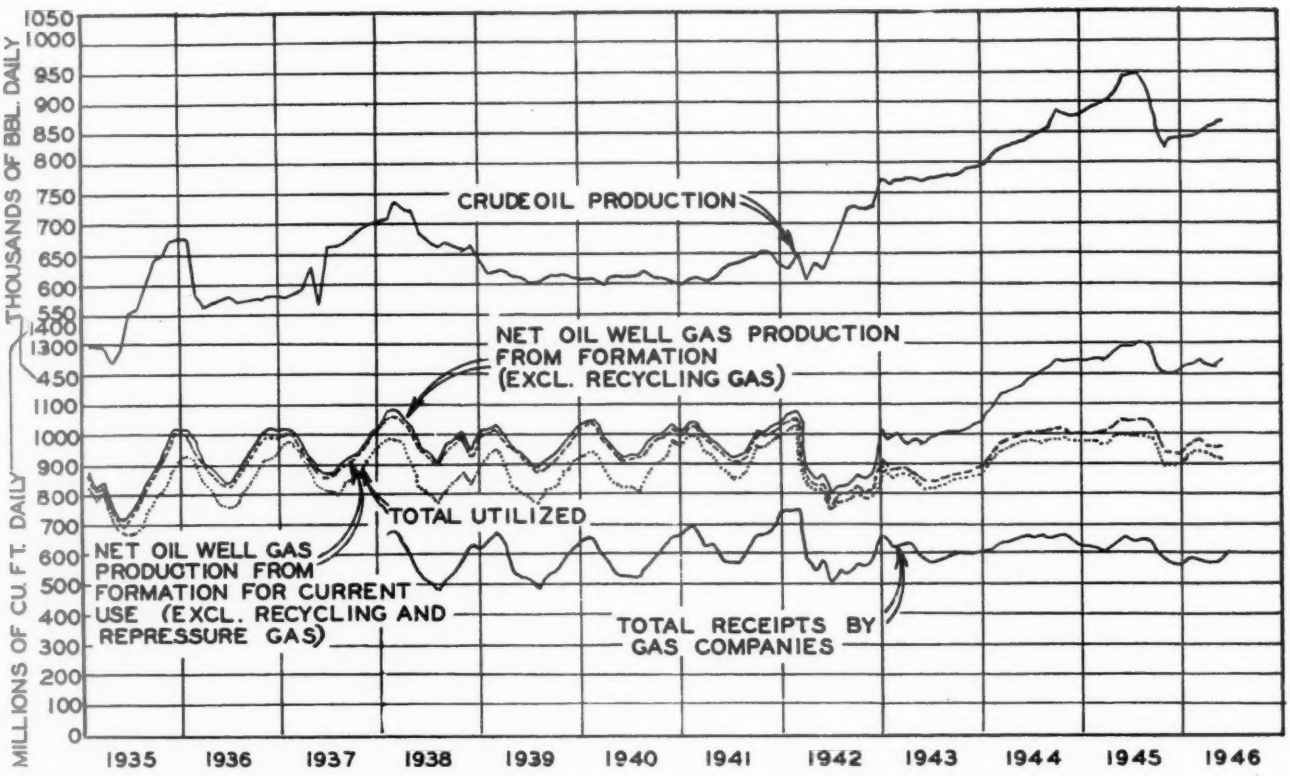

FIG. 2. California oil well gas production and disposition.

hensive study of predicted demands vs. prospective supply from local California sources. Based on all available information, we projected these estimates some years into the future, and the comparison disclosed a rather bleak prospect with respect to the adequacy of local supply to meet our needs. The forecasts showed conclusively that, should we continue to depend solely upon California sources, we should soon be confronted with a serious deficiency that would become progressively greater. This impending situation is due to the combined effect of rapid growth in firm demand and a progressive reduction in the oil-well gas available for sale to us. Under the pressure of military demands for petroleum products, California oil production was, at the end of the Pacific War, at the highest sustained level in the State's history, having increased from a prewar rate of approximately 600,000 bbl. per day to the so-called "maximum efficient rate of production" of about 940,000 bbl. per day in July, 1945. Despite this increase of more than 50 per cent in oil production, oil-well gas available to gas companies showed no increase during the war period and peak day availability actually diminished. This decline in the ratio of available gas to crude oil production has been well defined since 1941. It is partly due to reduced output of certain fields because of depletion, but principally to adoption of pressure maintenance in fields that had previously been a source of supply to us. With such change of status, a field ceases to provide any gas to us for the duration of the repressuring cycle. Since 1941 a number of important sources of residue gas have been thus eclipsed through repressuring, and this trend continues to be a major threat to the dependability of our local supply.

Following V-J day, with the termination or shrinkage of war-created demands for most petroleum products, the rate of oil production in California fell off abruptly, and is currently at a level of about 880,000 bbl. per day. This drop in oil production was accompanied by a corresponding change in available residue gas, while the program of shifting field output from market to pressure maintenance continues. This recent history indicates that California oil production has passed its peak, and hereafter will be subject to the inevitable decline accompanying depletion. This decline due to natural causes may be predicted with reasonable accuracy.

● **What about new fields?** Naturally we weighed the possibility that exploration might reveal new major sources of local gas and thus solve our supply problem, but the recent history of new oil and gas discoveries in producing areas tributary to our market has been extremely disappointing. Since 1939 there has been no major field discovered in Southern California, and the last two fields of importance from the standpoint of gas reserves, which were brought in in 1938-39, have been under pressure maintenance since the inception of their development, and hence are presently unavailable as gas sources. The implications of this failure to find new reserves during the war years are plain, when it is noted that this period saw the most intensive and sustained exploratory campaign in the State's history, under the impetus of war needs and an abnormally favorable tax formula.

We find ourselves confronted with a growing load and a dwindling rate of supply. The abnormal war-induced depletion of the State's oil and gas reserves undoubtedly will accelerate the rate of future decline.

● **What was done to provide a controllable natural gas supply before deciding to import Texas gas?** Over a period of years we have developed underground storage reservoirs, at La Goleta and at Playa del Rey, with a combined present average daily output deliverability, as limited by wells and/or pipe lines, of some 285,000,000 cu. ft., and storage capacity, within the effective pressure range, of some 17,500,000,000 cu. ft. This program entailed a capital expenditure of about $12,000,000 for reservoirs, backlog gas, injection and booster compressors and pipe lines. Without these supplemental facilities we would have been unable to meet winter peak firm demands by a large margin for several years past. But, and this is important, though frequently overlooked, underground storage is a secondary source, which must be cyclically replenished or it fails completely in a short time through exhaustion.

As our oil-well gas supply diminishes, either absolutely or in relation to consumptive requirements, we shall soon reach a point where our primary supply will not suffice to replenish underground storage, whereupon our peak day supply deficiencies will become enormous. It is both economically and physically feasible to augment output capacity of existing storage reservoirs, or possibly to utilize other local depleted oilfields for this purpose. Manifestly, however, such additions would accomplish nothing if our present storage reservoirs are going to dry up through inability to replenish

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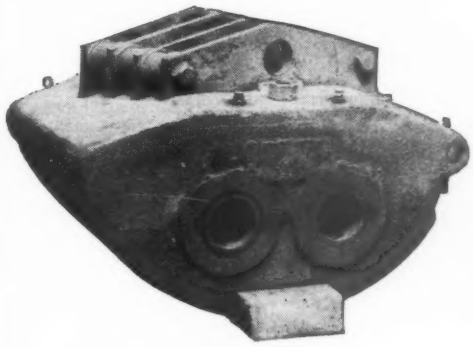

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them periodically. This is the situation that will soon confront us unless we provide a relatively large addition to our basic supply.

● **What about more extensive use of California dry gas fields, which would afford a primary supply having a production rate independent of petroleum market demands, and hence to a considerable degree controllable by the gas purchaser?** First, there are no important dry gas fields within reach of our existing transmission lines. In fact, the total dry gas reserves tributary to our Southern California systems equal only one-half of one per cent of the total State gas reserves. Gas from these fields, which, together with gas from our storage fields, comprises our only controllable supply, has for many years been carefully husbanded to maintain its deliverability for firm peak use.

Next, why not transport gas from Rio Vista and other dry gas fields of Northern California to the Los Angeles market? This possibility received exhaustive study, and early in 1944 we concluded that we could not safely rely upon these sources as a long-range solution to our problem. Subsequent investigation and developments tend to confirm the validity of this conclusion.

The most important reason for rejecting this source in favor of a Texas supply is that in the near future the predicted productive capacity of Northern California dry gas fields will be insufficient to support the combined winter draft of both Northern and Southern California. In common with most California dry gas reservoirs, Rio Vista is a water-drive field. Because of the heavy drafts in recent years and in order to prevent too rapid infiltration of bottom and edge water, the producers in this field have reduced drastically the allowable maximum production rate per well. In a recent two-year period it was necessary to increase the number of wells by 67 per cent to obtain a 10 per cent increment in field deliverability at the end of the period. The law of diminishing returns will limit the number of additional wells that can profitably be drilled, and therefore, long before the reserve is exhausted the field output capacity will have declined to a fraction of its present potential.

At the 1945 rate of production for Rio Vista, the ratio of estimated remaining recoverable reserves to annual depletion is about 19 years. If there is no further increase in Northern California's draft upon this field, and if we should transmit to Southern California an additional 200,000,000 cu. ft. per day, or approximately two-thirds of the maximum capacity of the Texas line, the indicated remaining life would be reduced to about 11 years. Under this premise Southern California would ultimately receive only 200,000,000 cu. ft. per day for 11 years from Rio Vista, equivalent to a cumulative total of approximately 800,000,000,000 cu. ft., as compared to some 3,000,000,000,000 during 30 years through the Texas line.

It is interesting to contrast the current ratios of annual production to estimated recoverable reserves for Rio Vista, with those for Hugoton, one of the major dry gas sources to be tapped by our Texas line. The comparative figures are as follows:

	Estimated recoverable reserves, commercially productive area, cu. ft.	1945 Production, cu. ft.	Ratio
Rio Vista..	3,000 billions	160 billions	18.7 years
Hugoton..	28,800 billions	204 billions	143 years

A 200,000,000 cu. ft. per day pipe line from Rio Vista to Los Angeles would cost approximately $19,000,000, as compared to $16,000,000 for a 300,000,000 cu. ft. per day line from the Colorado River, the comparative distances being 350 vs. 224 miles. At present field prices, and respective project expectancies of 11 vs. 30 years, the total delivered cost of Rio Vista gas would be 20 cents per 1000 cu. ft., as compared to approximately 17 cents for Texas gas.

Northern California is becoming progressively more dependent upon Rio Vista and the minor dry gas fields of that section, and as their share of the available residue oil-well gas declines this trend will continue. A considerable investment has been made to transport Rio Vista gas to Northern California markets, and these facilities, with necessary future additions, are adequate to deplete this reserve completely in a relatively short span of years. Construction of a line from Rio Vista to Los Angeles would constitute an unnecessary duplication of existing capital, and the supplying of even part of Southern California's deficiency requirements through such a line would further accelerate the depletion of, and in a few years, exhaust, this reserve, which is so essential to the continued service of natural gas in Northern California. Therefore, especially if an alternative supplemental supply can be obtained for Southern California, a large-scale diversion of Rio Vista gas to Southern California markets clearly

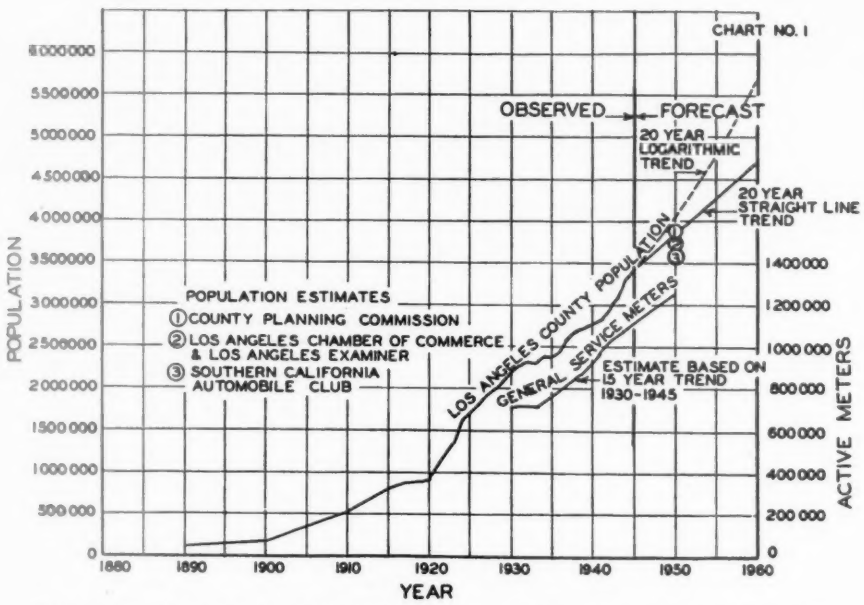
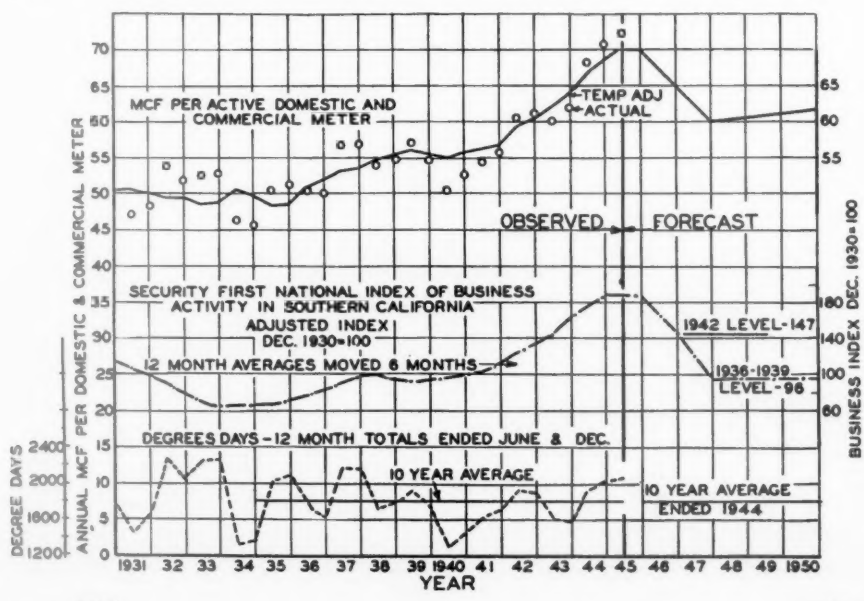


FIG. 3. Population of Los Angeles County and general service active meters.

FIG. 4. Requirements per active meter vs. business conditions and degree days.


MCF PER ACTIVE DOMESTIC AND COMMERCIAL METER
TEMP ADJ ACTUAL
OBSERVED
FORECAST
SECURITY FIRST NATIONAL INDEX OF BUSINESS ACTIVITY IN SOUTHERN CALIFORNIA
ADJUSTED INDEX DEC. 1930=100
12 MONTH AVERAGES MOVED 6 MONTHS
1942 LEVEL-147
1936-1939 LEVEL-96
DEGREES DAYS - 12 MONTH TOTALS ENDED JUNE & DEC.
10 YEAR AVERAGE
10 YEAR AVERAGE ENDED 1944
ANNUAL MCF PER DOMESTIC & COMMERCIAL METER
DEGREE DAYS
BUSINESS INDEX DEC. 1930=100
YEAR

INSIDE and OUT

Positive Visual Inspection Assures Greater Dependability in Republic Electric Weld Line Pipe

Republic Electric Weld Line Pipe is made of highest quality flat-rolled steel, cold formed into tubular shape and electrically welded into strong, sound pipe. Thus, the surface which becomes the inside wall of the pipe is free from hidden defects, because it is inspected just as closely as the outside surface.

Inside and outside, you are assured of clean, sound, scale-free surfaces throughout every length of Republic Electric Weld Line Pipe.

Why? Because Republic Line Pipe is cold formed from flat-rolled steel, both sides of which are open to close visual inspection. Until the moment when it is formed and electrically welded into a strong, sound tube, every square inch of the inside surface passes the eyes of watchful inspectors.

But that's not all! As an added safeguard of uniformly high quality, sections from the weld area are tested and every length of pipe is subjected to a hydrostatic pressure well in excess of that which may be encountered in actual service.

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Because this *modern* line pipe is cold formed and sized, it contains an absolute minimum of valve-clogging scale. Thus there is no possibility of pipe failure due to rolled-in scale breaking loose and leaving a thin section in the wall.

Republic Line Pipe goes in the ground fast, because it is consistently uniform in *Straightness, Roundness* and *Wall Thickness.* Its uniformly *High Ductility* and *Weladability* speed up bending and joining operations, while its *Long Lengths* mean fewer joints and decreased construction costs.

In the past fourteen years, more than 40,000 miles of Republic Line Pipe have gone into service throughout the oil and gas industries —further assurance that you can specify the name "Republic Electric Weld," with complete confidence.

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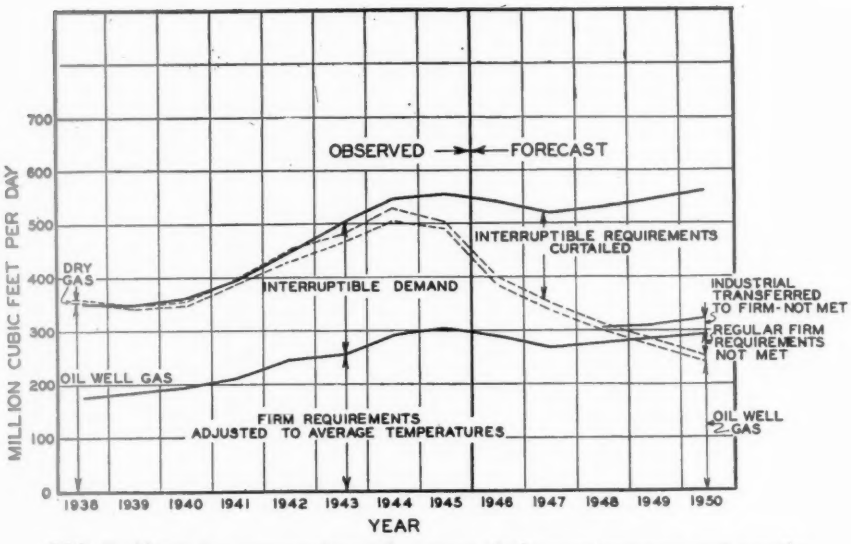
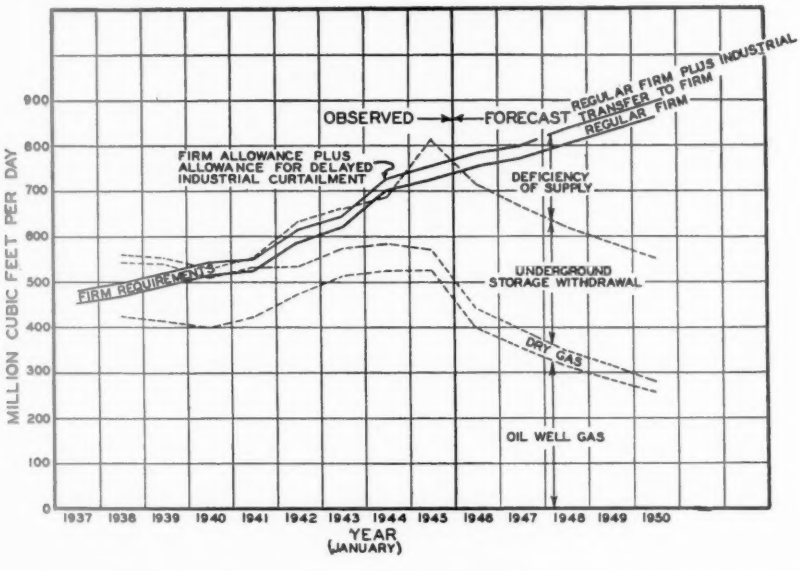


FIG. 5. Above is a comparison of average daily requirements and supply.

FIG. 6. Firm peak day requirements vs. supply, with indicated deficiency.



would not be in the public interest, considering the entire State.

Finally, if we should seek temporary relief by a line to Rio Vista, involving a large capital outlay, it appears certain that the only large remaining reserves in Texas, to which we must look for a long-range solution of our supply problem, would be irrevocably committed to other markets and we should thus "miss the boat."

Next, a word to indicate the relative magnitude of our industry in California. The most recent available statistics show that California had 23 per cent of the nation's consumers of natural gas, and used 20 per cent of the total domestic and commercial consumption. Our rate of population growth is relatively high. Thus, during the 1930-40 decade our State population increased 21.8 per cent, approximately three times the national average of 7.5 per cent, and in the succeeding five years ended July, 1945, we experienced a further growth of 27.7 per cent (exclusive of armed forces overoverseas),.compared to 0.2 per cent for the nation as a whole.

The charts which I shall now show you, graphically portray the prospective critical supply vs. demand relationship that I have outlined.

In forecasting requirements it is customary to estimate separately the two components of meter growth and unit consumption, and then multiply these factors to obtain total load.

Fig. 3 shows the historical and the predicted combined meter growth of Southern California and Southern Counties companies, and its relation to the population curve for Los Angeles County, in which some 83 per cent of our meters are located. On the basis of the linear trend for the last 15 years, total meters will reach 1,250,000 in 1950, and the corresponding county population figure is 3,870,000. This is equivalent to an annual meter growth of 27,000.

On Fig. 4, the unconnected dots show the actual annual domestic and commercial unit consumption, and the upper solid line shows these data adjusted to compensate for the effect of temperature variation from a 10-year average. The adjusted unit consumption increased from 50,000 to 70,000 cu. ft. per meter per year during the 10-year period ending with 1945. The 1945-50 forecast reflects a temporary decline accompanying an expected business recession during this period. The timing of this decline is of course quite uncertain.

Fig. 5 gives a direct comparison of predicted average supply vs. demand for the next few years, and clearly shows the critical situation facing us. The lower solid line is a plotting of total average daily firm load derived from the unit figures supporting the last two charts shown. The upper solid line represents total potential load, including industries served on an interruptible basis. The dotted lines show average available daily supply, the lower line being residue oil-well gas, and the upper, total, including dry gas. Storage gas is not shown, since this is a seasonal operation involving annual replenishment, and hence, with a balanced storage cycle, it does not affect the average daily supply figures for a given year. Observe that about 1949 the converging supply and firm demand lines intersect, and thereafter we would lack natural gas to supply even average firm load, with interruptible industrial sales entirely eclipsed, as shown. Should the firm requirements follow the prewar growth trend after 1945, as indicated by this extrapolated line, the critical intersection point would be advanced to early 1948. Beyond the intersection in 1948 or 1949, the predicted deficiency increases quite rapidly, as the supply and demand curves are divergent. To date this trend has been evidenced by a sharp rise in the forced curtailment of industrial load. This curtailment increased from about 2,000,000,000 cu. ft., or 2.5 per cent of potential load in 1942, to an estimated 47,500,000,000 cu. ft., or 48 per cent in 1946.

With the recession of petroleum and oil-well gas production to prewar levels in the near future, followed by the inevitable decline due to depletion, industrial curtailment will continue to mount rapidly, becoming practically complete in 1949. In 1950 the local supply expected to be available to us will fail to meet average firm requirements by 70,000,000 cu. ft. per day.

Fig. 6 shows an even gloomier picture —the estimated local supply vs. demand for peak day conditions, based on minimal temperatures such as prevailed during the winter of 1936-37. This indicates a natural gas deficiency in the winter 1948-49 of some 276,000,000 cu. ft. per day, despite maximum delivery from existing underground storage sources.

In the fall of 1943, after careful study of the expected supply vs. demand trends, which I have summarized, we were reluctantly forced to the conclusion that there are within the State no known long-lived, dependable and economical sources of natural gas that would afford a means of augmenting our existing supply, and therefore it had become vitally necessary that we seek and obtain without delay a major out-of-state source.

(Part 2 will be published soon)

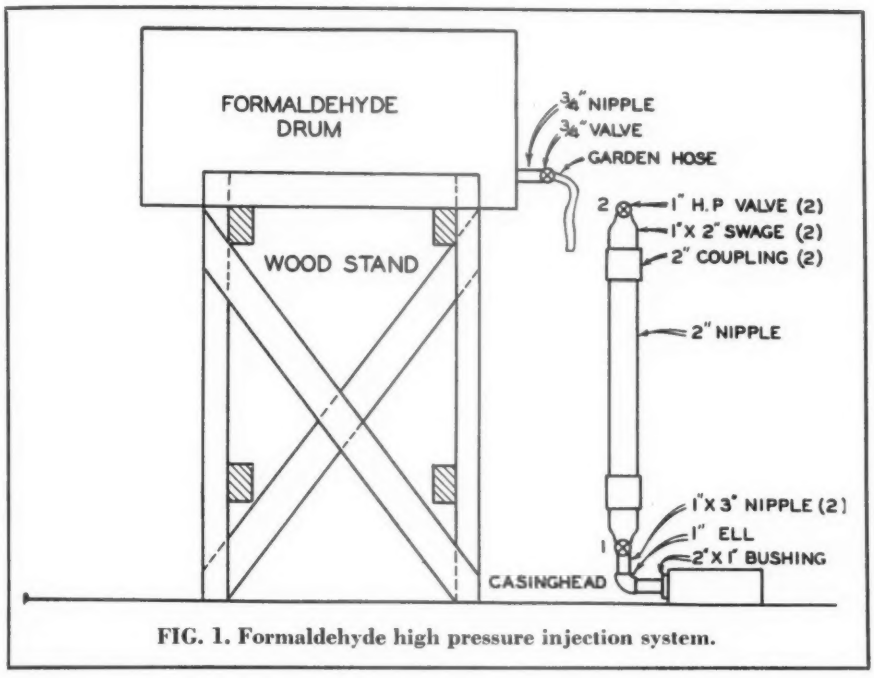


FIG. 1. Formaldehyde high pressure injection system.

Use of formaldehyde to inhibit corrosion

By **JAMES A. CLAY, JR.**, Service Engineers, Inc.

THE applicability and results of the use of formaldehyde as an inhibitor of corrosion due to hydrogen sulphide saturated brines have been ably presented in a recent paper[1], and further experience has borne out the first contention, namely, when properly applied and maintained, formaldehyde injection will appreciably reduce hydrogen sulphide corrosion of oil field equipment. When applying formaldehyde to a corrosive well, one should understand that there may be factors, or causes, other than hydrogen sulphide saturated brines that are contributing to the corrosion damage. There have been several instances in which formaldehyde was about to be declared a failure when large electrolytic currents were found, and the trouble stopped, or greatly reduced, when the media carrying those currents were insulated.

EXCLUSIVE

A discussion of electrolytic currents is not within the scope of this paper; however, a thorough discussion of this subject may be found in the U. S. Bureau of Mines Bulletin No. 233, by R. Van A. Mills, published in 1925. Although Mill's article is some 20-odd years old, the principles and theories in it still hold, and it is believed that much benefit will be gained by reading it.

When using formaldehyde, or any other liquid chemical, as a corrosion inhibitor, it is the usual practice to inject the chemical down the annulus between the tubing and the casing of a well, allowing the chemical to drop down the annulus to the bottom of the well and be circulated through the tubing. The injection is usually made through one of the 2-in. openings in the casinghead. In the case of formaldehyde, several different types of injection systems have been tried. Some have succeeded, others have failed. Various well hook-ups and well conditions require different types of systems. The most successful and simple systems yet devised may be separated into two classes, those for high pressure wells and those for low pressure wells. For high pressure wells, a lubricator of some type has been found very satisfactory, and two examples of these may be seen in Figs. 1 and 2. In Fig. 1 is shown a drawing of a small high-pressure lubricator to be used on extremely high pressure wells in conjunction with a wooden stand and a drum of chemical. A barrel pump may be used in lieu of the stand.

The operating procedure is to close valve No. 1, open valve No. 2, open the valve on the drum and drain the desired amount into the lubricator, close the drum valve and valve No. 2, and then open valve No. 1, letting the formaldehyde drain into the well. The lubricator is of such length that it will hold just the amount to be injected. If a smaller amount is to be injected at a later date, a smaller nipple can be installed or the amount to be injected can be diluted to fill the lubricator. The cost of this type of system is approximately $75.00 installed, including the wooden stand or barrel pump.

In Fig. 2 is shown a tank type lubricator equipped with a gauge glass, bleeder, and equalizer line. This lubricator is made of 14-in. O.D. casing, and it is 48 in. long, thus, holding approximately 25 gal. of fluid. The gauge glass is usually marked off in one quart intervals to facilitate the measurement of the chemical. Some trouble has been experienced with the plugging of the feeder line and equalizer line, when made of 5/16-in. O.D. copper tubing, with paraformaldehyde. Paraformaldehyde is a white to gray colored substance that may precipitate from the standard 37 per cent U.S.P. solution of formaldehyde when subjected to temperature below about 80°F., or a sudden decrease in temperature, even though small. Such deposits may be prevented by diluting the U.S.P. solution with fresh water, or by using a newer type of formaldehyde now on the market. The new type of formaldehyde is chocolate brown in color and, besides having good antifreeze characteristics down to minus 10°F., no paraformaldehyde drops out of solution. The solution is 25 per cent by weight formaldehyde as compared to the standard 37 per cent U.S.P. grade. The tank is refilled through a plug at the top, the drum being left at the well and the fluid transferred by means of a barrel pump and a short piece of garden hose. The cost of this system installed is approximately $85.00.

In Fig. 3 is shown the simplest and most economical type of injection system, and is used on wells that have a casinghead pressure of less than 50 lb. per sq. in. The system consists of nothing more than the drum as the container, a common barrel pump or grease pump, and sufficient ½-in. pipe and connections to hook it up to the casinghead opening. The procedure then consists of nothing more than opening the valve and cranking in the desired volume.

The Permian Basin of West Texas-New Mexico, and some parts of California, Oklahoma, Kansas, Arkansas, Wyoming, and other states, are known to have corrosion trouble due either directly or indirectly to hydrogen sulphide saturated brine. Formaldehyde has been definitely proved an inhibitor for this type of corrosion. Formaldehyde has also been used to some extent as an in-

1. "Formaldehyde as an Inhibiter of Corrosion Caused by Hydrogen Sulphide Saturated Brines," P. L. Menaul, *Petroleum Technology*, January, 1946.

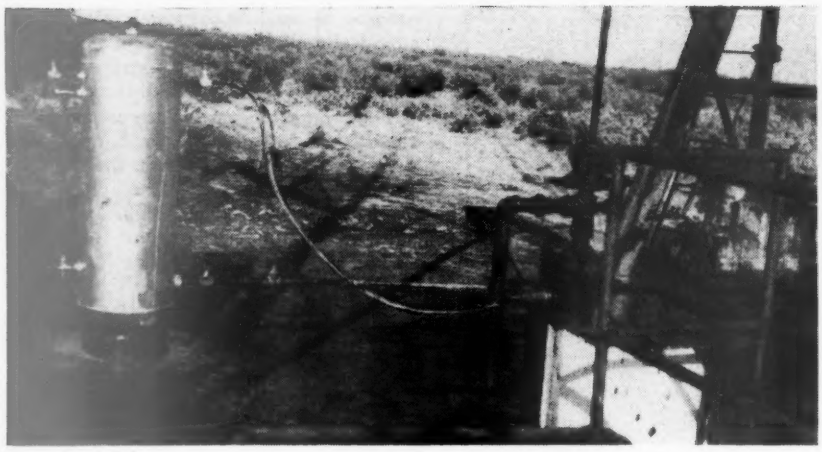


FIG. 2. High pressure injection system.

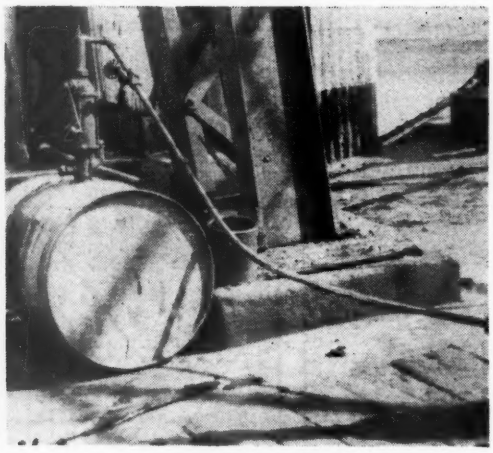


FIG. 3. Low pressure injection system.

hibitor in the manufacture of certain acids, and will therefore act as an inhibitor against those well fluids that are slightly acidic.

Formaldehyde is a good acid inhibitor at low temperature, but its efficiency decreases as the temperature increases. For this reason it is not suitable for use in wells exhibiting a high bottom hole temperature. Corrosion of production equipment in sour crude fields is usually dormant until water appears in the produced fluids; however, the amount of water necessary to cause severe corrosion is unknown and corrosion may occur when the water produced is negligible. The failure of stock tank decks in sour areas, in many instances, may be attributed to the condensation of water vapors on the roof of the tank in the presence of hydrogen sulphide, either with or without the presence of oxygen. The presence of oxygen usually will accelerate the rate of corrosion, although its presence is not believed absolutely necessary for corrosion to occur. Cases have been brought to the attention of the writer where a well was corrosive when no electrolytic current could be found in the lines connected to the well, and when no water was produced. If water was produced, it was of the order of 1/10 of one per cent, and all the produced fluids passed as pipe-line oil. From an inspection of the subsurface equipment and its pit pattern, it was concluded that the attack was primarily due to chemical causes and therefore must have come from a hydrogen sulphide saturated brine. Consequently, there must have been sufficient water or water vapor in the well to result in the damage. The presence of some water in most oil wells is evidenced by a few droplets of water hanging to the subsurface equipment when it is pulled from a well. In such a case, formaldehyde should be applicable.

Two years of experimentation have shown that, although formaldehyde may not always be 100 per cent effective as an inhibitor, it is usually at least 80 per cent effective when properly used. In many cases, overall pulling expenses have been reduced by 75 per cent, the remainder of the pulling jobs being attributed to such needs as replacing cups, worn pumps and barrels, sanded up balls and seats, etc. It must be kept in mind, however, that our present knowledge suggests that formaldehyde is good for only two types of corrosion, that due to hydrogen sulphide saturated brines or acids at low temperatures.

A point that cannot be stressed too greatly is that formaldehyde will not make damaged equipment whole again, and that if the equipment in a well is severely corroded, the cost of the treatment will be wasted. If the equipment in a well is in good condition, possibly partly damaged by corrosion but not very severely, treatment with formaldehyde may prove of benefit for a year or perhaps two years, at which time numerous failures may begin to occur. These failures will not be the fault of the treatment nor indicate that the formaldehyde is unsuitable. The situation is that the equipment has reached the end of its useful life due to its fatigue strength being reduced by the presence of hydrogen sulphide and/or salt water, and by the material actually being overstressed at certain locations by stress concentration points at places of previous pitting. As an example, let us assume that the endurance limit of sucker rod steel is 100,000,000 flexures or stress reversals. At 18 strokes per minute the rods should last for approximately 10½ years in 24-hr. daily service. The reduction in the endurance limit because of the presence of hydrogen sulphide and/or salt water may be of the order of 50 to 80 per cent, dividing factor of 2 to 5. Thus, the life of the rod string may be reduced to from 2 to 5 years. The stress concentration factor may be as high as 2, which means that the load carrying capacity has also been reduced by 50 per cent. The most benefits, of course, will be derived from the treatment of new equipment that does not have any pits that could result in a stress-concentration point.

When preparing to treat a well with old equipment in it, it is advisable to clean the sulphide scale from the old material. Most wells in sour crude areas eventually will get a hard, black, brittle scale on the rods and tubing. This scale, the product of the reaction of the sulphides in the well fluids and the metals in the well, consists of the sulphide salts of those metals. This scale may form a galvanic couple with the metals and cause additional corrosion damage to the metals and/or accelerate other types of corrosion.

It is believed that formaldehyde reacts chemically with the sulphides in the well fluids and the product of that reaction forms an extremely thin film over the subsurface equipment. This film is only a few molecules thick, perhaps of the order of 1/100,000 of an inch, manifesting its presence by a light violet or bluish tarnish on polished surfaces. It will not remove the sulphide scale already formed but it will prevent the scale from forming on a clean surface. As corrosion of the metal under the scale will continue for some time, and for other reasons stated above, it is advisable to remove as much scale as possible before treatment is begun so that the protective film can be formed on the metallic surface itself. The scale can be removed by the injection of a small amount of inhibited 15 per cent hydrochloric acid down the annulus of the well while the well is producing. If the acid does not completely remove the scale it will soften it to such an extent that the scale will subsequently slough off and be pumped out. As yet no bottom-hole pumps have been plugged as a result of loosened scale; so it has been concluded that the particles of scale so loosened have sufficient area in proportion to weight to be carried out by the usual fluid velocities found in a pumping well.

Experience has shown that the best results from formaldehyde will be obtained if the following conditions are observed:

1. The formaldehyde must be injected every day in order to maintain the thin protective film. In the case of an extremely large water-producing well batch treatment twice daily is recommended. The batch treatment is recommended over the drip or continuous feed type because it is believed that the large volume of liquid injected at once, falling like a cascading waterfall, uniformly coats the inside of the casing and the outside of the tubing. Also, more of the formaldehyde will reach the bottom of the well and be circulated out.

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FASTER TRIPS Risk of hitting crown is reduced, permitting faster operations, quicker round trips, more time on bottom.

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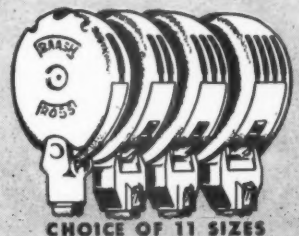
Baash-Ross DB Unitized Blocks are available in two basic types—either with Hook (left) or with Link Adapter Unit (large illustration). Both styles are free-swiveling . . . or can be instantly locked in any one of 8 different positions. Also, both are spring loaded. Link Adapter unit is recommended for maximum capacity and simplicity.



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Not only are there two basic types of DB Blocks, but each type is available in choice of 1, 2 or 3 sheave models with capacities of 30, 65 and 100 tons, respectively, and each in choice of 20", 24" or 30" sheave diameters . . . or in a 4 sheave model with 150 ton capacity and choice of 30" or 36" diameter sheaves. There's a size for every job—one for *your particular* requirements!

For more information see your nearby Baash-Ross representative. Or write direct.

2. Wells must be produced daily if possible, so that a circulation of formaldehyde occurs each day.

3. The injection system should be closed if possible to exclude air. Such action will aid in the reduction of corrosion by the elimination of oxygen.

4. The formaldehyde must reach the bottom of the well. When large quantities of gas are taken from the casinghead this process must be discontinued for a few minutes to provide sufficient time for the chemical to reach the bottom well fluids, so that it will not be blown out into the gas line.

5. When a low pressure well is treated, one in which there is so little gas present at the casinghead that a flare will not burn continuously, precautions should be taken to close in the casinghead completely, so that the well cannot suck air as it pumps down. If closing in the casinghead reduces the producing capacity of the well, one of the casinghead openings can be equipped with a small petcock, or similar device, through which the excessive pressure may be bled off.

6. Periodic checks of the hydrogen sulphide content of the produced water, and of the efficiency of any insulation material used, should be made to make sure that the proper operating conditions are maintained.

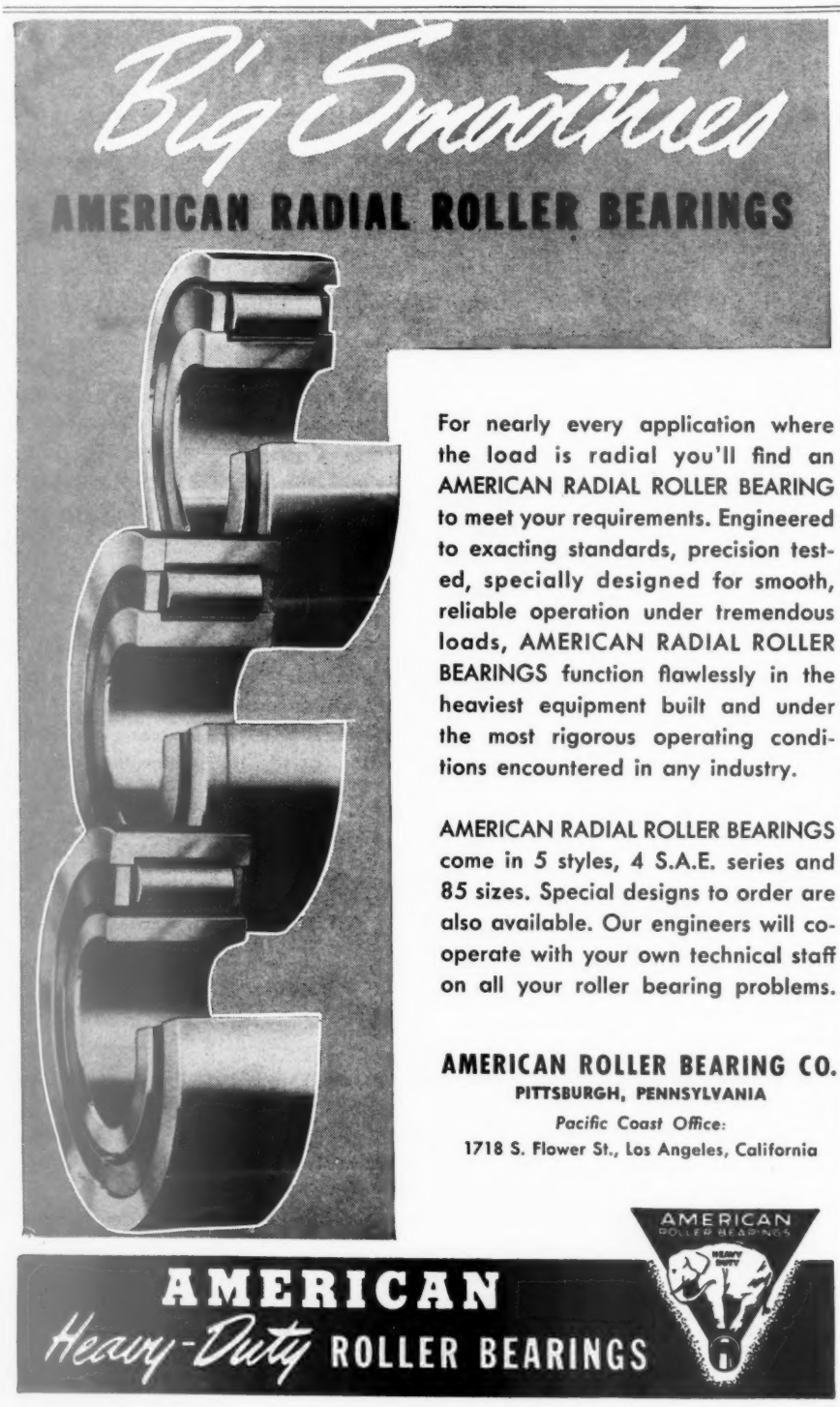
7. When treating a well with old equipment in it, first remove the sulphide scales.

When handling and administering formaldehyde certain precautions should be taken in order to protect personnel and to obtain the best results. Formaldehyde is a toxic chemical whose fumes are irritating to the membranes of the eyes, nose, and throat. Moreover, the liquid will act as a minor skin irritant to some people. The fumes should be avoided as much as possible. Any ammoniated hand-cleansing cream will counteract the effects of formaldehyde should the liquid come in contact with the skin. The cream should be applied immediately after contact, for it will have less effect if it is applied at some later period. The application of quantities of fresh water will alleviate the stinging sensation of the eyes when they are irritated by the fumes.

Formaldehyde is sold in steel drums, either plastic or rubber lined, which contain a net weight of 475 lb. of formaldehyde solution, equivalent to approximately 52 gal. The standard solution is 37 per cent formaldehyde by weight, 40 per cent by volume, the remainder being fresh water and about 10 to 14 per cent methanol to prevent freezing. Another solution, 25 per cent by weight, is available that will eliminate the formation of paraformaldehyde, even to a temperature as low as minus 10°F.

The amount of formaldehyde to use must be scientifically determined for each well. It varies according to the amount of surface area of equipment to be covered by the protective film, usually a function of the total depth of the well; the dilution effect of the produced fluids, a function of the amount of water produced; and the severity of the corrosion, a function of the amount of hydrogen sulphide dissolved in the water or the acidic characteristics of the water. There are no tests known to the writer by which the precise optimum rate of injection can be determined. The amount initially recommended is based on past experience and a correlation with the conditions met in other wells. Subsequent inspection of the subsurface equipment sometime after injection has been started will indicate the efficiency of the treatment. Treatment the first day may vary from 2 to 5 gal. During the next 60 to 120 days, a treatment of from 2 to 4 quarts per 100 bbl. of water produced is used, after which regular treatments of smaller amounts prove satisfactory. The purpose of the large initial treatment is to saturate the well fluids and equipment as quickly as possible. If only one quart per day is to be injected, it is recommended that the chemical as received be diluted about 50 per cent with fresh water, so that sufficient volume will be injected at one time to insure most of the chemical reaching the bottom of the well. No damage occurs through the use of an excessive amount of formaldehyde, but such action of course results in an additional expenditure with no additional benefits.

★ ★ ★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For nearly every application where the load is radial you'll find an AMERICAN RADIAL ROLLER BEARING to meet your requirements. Engineered to exacting standards, precision tested, specially designed for smooth, reliable operation under tremendous loads, AMERICAN RADIAL ROLLER BEARINGS function flawlessly in the heaviest equipment built and under the most rigorous operating conditions encountered in any industry.
AMERICAN RADIAL ROLLER BEARINGS come in 5 styles, 4 S.A.E. series and 85 sizes. Special designs to order are also available. Our engineers will cooperate with your own technical staff on all your roller bearing problems.
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Pacific Coast Office:
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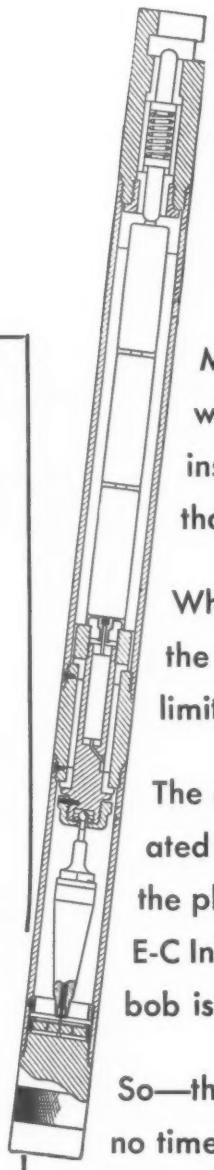
AMERICAN
ROLLER BEARINGS
AMERICAN
Heavy-Duty ROLLER BEARINGS

E EA-SY C Inclinometer
versus
Mechanically operated instruments



6 WAYS OF USING THE E-C

1. On Measuring Line.
2. On Sand Line.
3. As a Go-Devil and recovered when changing bit.
4. As a Go-Devil and picked up with a core-barrel overshot.
5. Run in with a core-barrel overshot when picking up a core.
6. Run inside of bailer in cable tool drilling.

Many cases have been brought to our attention where records made by mechanically operated instruments showed much greater deviation than that which actually existed.

When the E-C Inclinometer was brought on the job the deviation was actually found to be within the 2° limit.

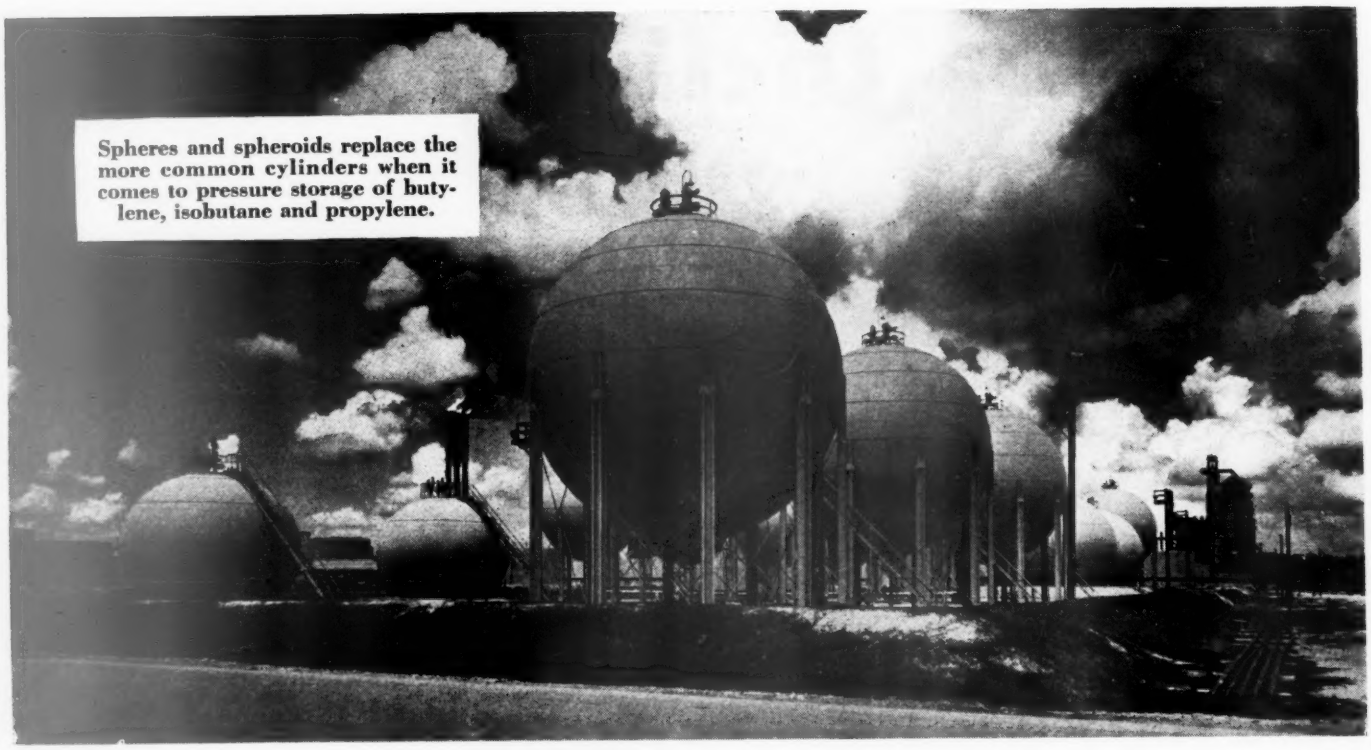
The answer lies in the fact that in mechanically operated instruments, it is possible to make a record *before* the plumb bob comes to a standstill. In the case of the E-C Inclinometer, *no record is possible* unless the plumb bob is at rest.

So—there's no uncertainty—no new runs necessary—no time lost. That's why operators everywhere are turning to the E-C.

SPERRY-SUN

SPERRY-SUN WELL SURVEYING COMPANY

Offices: Philadelphia, Pa.; Houston, Corpus Christi, Falfurrias, Marshall, Odessa, Texas; Lafayette, La.; Long Beach, Bakersfield, Calif.; Oklahoma City, Okla.; Casper, Wyo.



Spheres and spheroids replace the more common cylinders when it comes to pressure storage of butylene, isobutane and propylene.

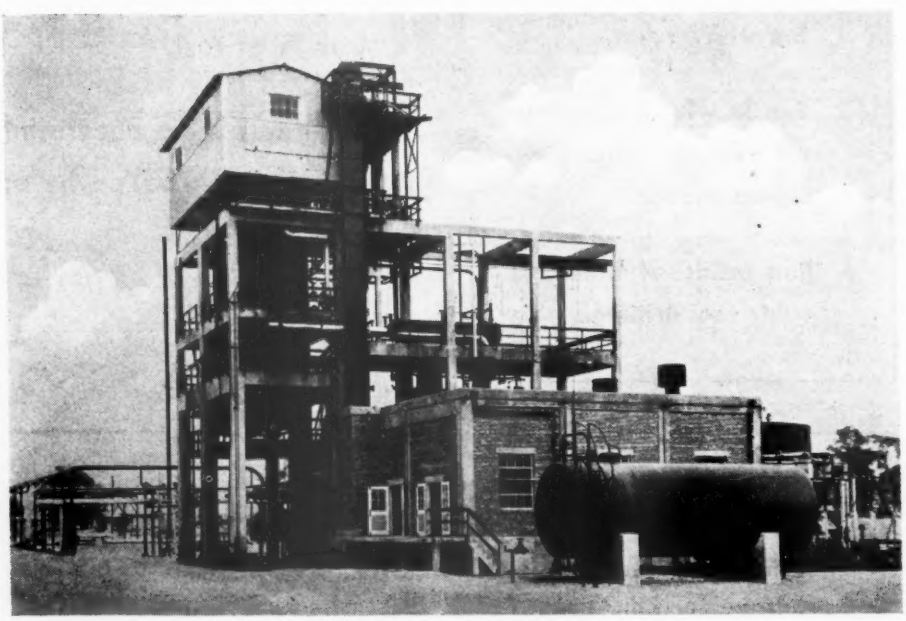
Alkylation and polymerization*

Analysis of effect on refinery earnings of the two processes

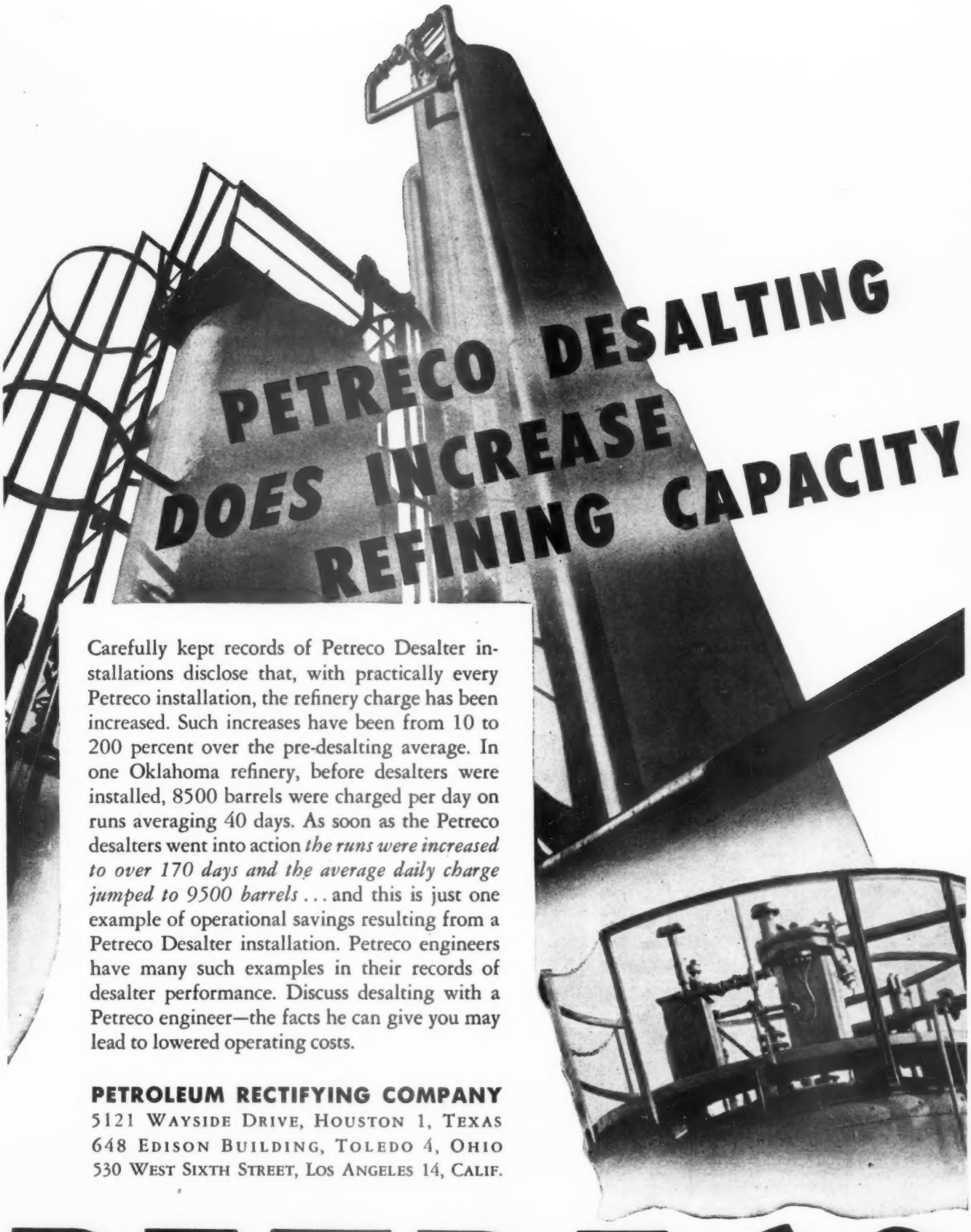
As alkylation and catalytic polymerization, the two foremost processes for manufacture of high octane gasoline from what would otherwise be refinery fuel, are competitive with one another, they have naturally been the subject of detailed study by our engineers and economists. At this time when refineries all over the country are being modernized, we hope our findings will be of some assistance to refiners in gauging their own octane position.

Generally speaking, both processes are similar in that the raw materials charged are light refinery gases that are high in octane rating but so volatile that, because of vapor pressure specifications, only a portion of the amounts available at most refineries can be blended directly into motor gasoline. After chemically uniting pairs of these light molecules through either alkylation or polymerization, however, the new high octane products produced boil within

Normal butane can be catalytically converted into isobutane simply and relatively inexpensively in butane isomerization units such as the one pictured below.



*First published in *The Kellogram*, No. 4, 1946, issued by The M. W. Kellogg Company.



PETRECO DESALTING DOES INCREASE REFINING CAPACITY

Carefully kept records of Petreco Desalter installations disclose that, with practically every Petreco installation, the refinery charge has been increased. Such increases have been from 10 to 200 percent over the pre-desalting average. In one Oklahoma refinery, before desalters were installed, 8500 barrels were charged per day on runs averaging 40 days. As soon as the Petreco desalters went into action *the runs were increased to over 170 days and the average daily charge jumped to 9500 barrels* . . . and this is just one example of operational savings resulting from a Petreco Desalter installation. Petreco engineers have many such examples in their records of desalter performance. Discuss desalting with a Petreco engineer—the facts he can give you may lead to lowered operating costs.

PETROLEUM RECTIFYING COMPANY
5121 WAYSIDE DRIVE, HOUSTON 1, TEXAS
648 EDISON BUILDING, TOLEDO 4, OHIO
530 WEST SIXTH STREET, LOS ANGELES 14, CALIF.

PETRECO

DESALTING ★ *ELECTRICAL PROCESS* ★ DEHYDRATING

the gasoline range and can be added in any proportion to refinery gasoline to increase its quantity and quality.

Therefore, a major advantage of both processes is that they substantially increase refinery gasoline output at the expense of fuel gas constituents. A second and equally important advantage is that the product from alkylation and polymerization has a CFR-M "blending" octane rating well over 90 and can be used for blending purposes to upgrade the refinery base stock gasoline. Both factors must be considered when the value of these processes is estimated.

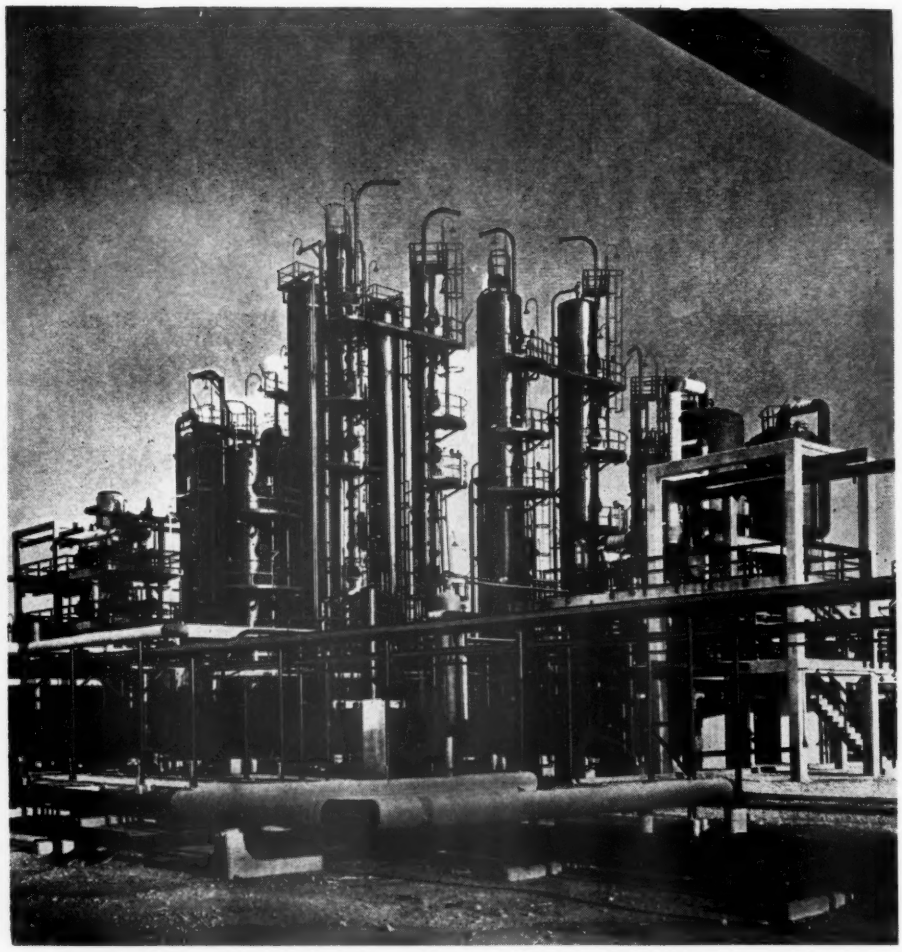
● **Refining area influences process economics.** Based on operating plants in existence today and disregarding factors of initial investment and depreciation, three general conclusions may be drawn from our studies of alkylation and polymerization unit operation:

First, currently, polymerization is the more profitable of the two in the Chicago and East Coast refining areas.

Second, alkylation has a slight edge in the Gulf Coast and Mid-Continent refining areas where extraneous isobutane is available at low cost.

Third, the value of alkylation will assume more attractive proportions in all areas as the octane rating of motor fuel increases.

In arriving at these conclusions the factors of relative yields, availability of raw materials, relative operating costs and relative manufacturing costs were evaluated.

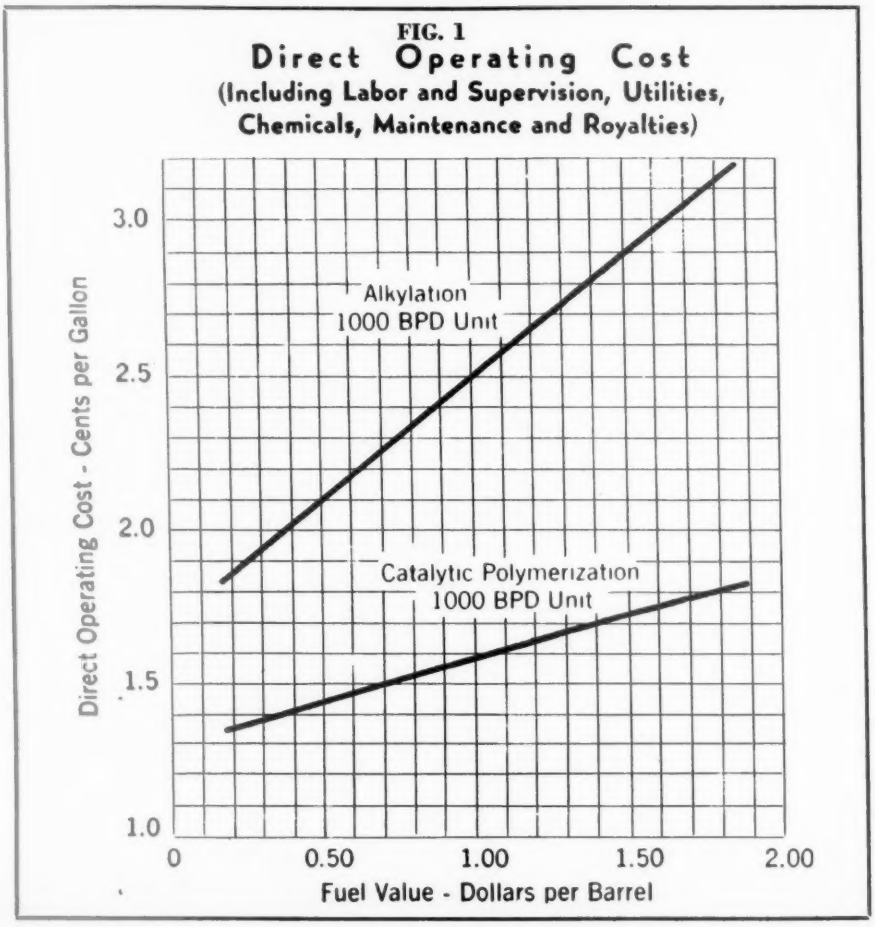


In these slender gas recovery towers, light petroleum gases for the alkylation and polymerization processes are separated from the gas stream.

FIG. 1

Direct Operating Cost

(Including Labor and Supervision, Utilities, Chemicals, Maintenance and Royalties)



● **Alkylation slightly more efficient from yields basis.** Taking as a base the production of 1000 bbl. per day of alkylate and polymer, the following table shows the kind and amount of raw materials needed:

Alkylation and catalytic polymerization yields.

	To produce 1000 bbl. per day of alkylate	To produce 1000 bbl. per day of polymer
Butylene, bbl. per day.....	585	775
Isobutane, bbl. per day.....	673	..
Propylene, bbl. per day.....	..	517
Total feed, bbl. per day.....	1258	1292

Although alkylation appears to enjoy a slight superiority from a yield standpoint, these figures as applied to refineries in various sections of the country must be tempered by the availability of raw materials in the areas concerned.

● **Raw materials a major factor in determining relative value of processes.** For example, in the Gulf Coast and Mid-Continent areas there exists an abundance of low cost natural gas and also

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Midwest has a Construction Department which has erected piping of all kinds for 46 years. The critical attitude of this department is the best stimulant to our four pipe-fabricating plants. The Construction Department also frequently contributes useful and practical suggestions for improving pipe fabrication.

This situation has a powerful effect in keeping the whole organization alert . . . and in encouraging continuous improvement. It is one of many reasons why you get the best when you buy Midwest Pre-Fabricated Piping . . . either as materials furnished or piping completely installed.

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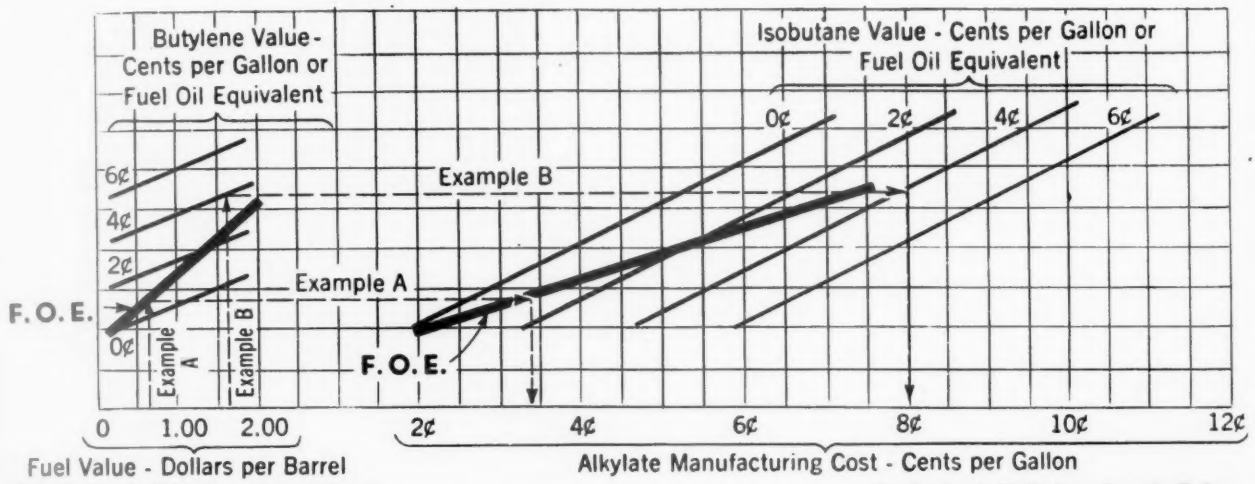
2266

FIG. 2

MANUFACTURING COST FOR 1000 BBL. PER DAY ALKYLATION UNIT



Method of Utilizing Above Graph

As Example A, when fuel is worth 60 cents per barrel and butylene and isobutane are valued at their F.O.E., the manufacturing cost of alkylate is 3.4 cents per gallon.

As Example B, when fuel is worth $1.60 per barrel, butylene 4 cents per gallon and isobutane 4 cents per gallon, the manufacturing cost of alkylate is 8 cents per gallon.

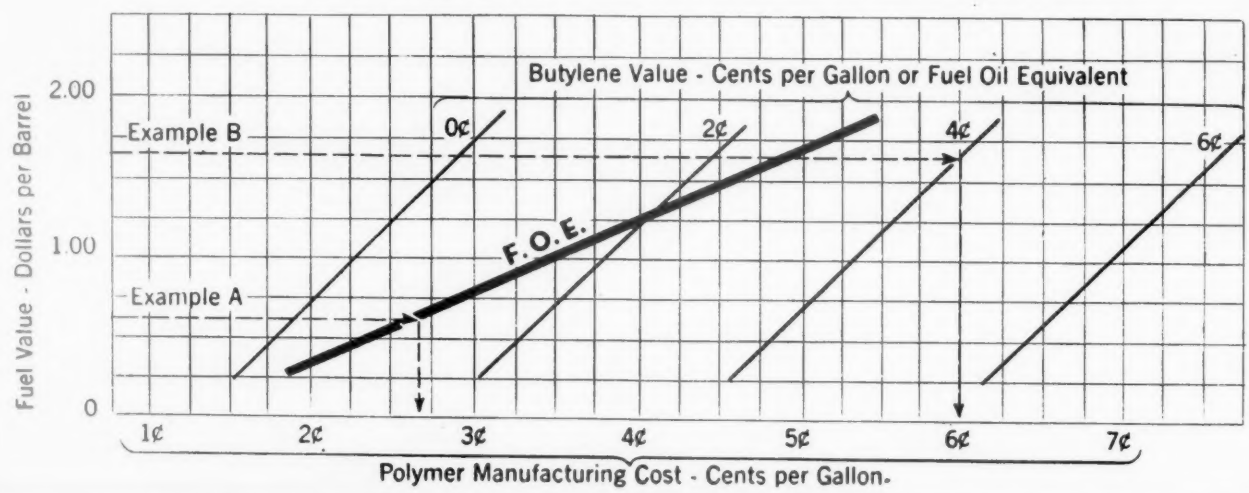
Note: ***The heavy lines represent the Fuel Oil Equivalent (F.O.E.) of butylene and isobutane and are employed when their only alternate use would be as fuel.***

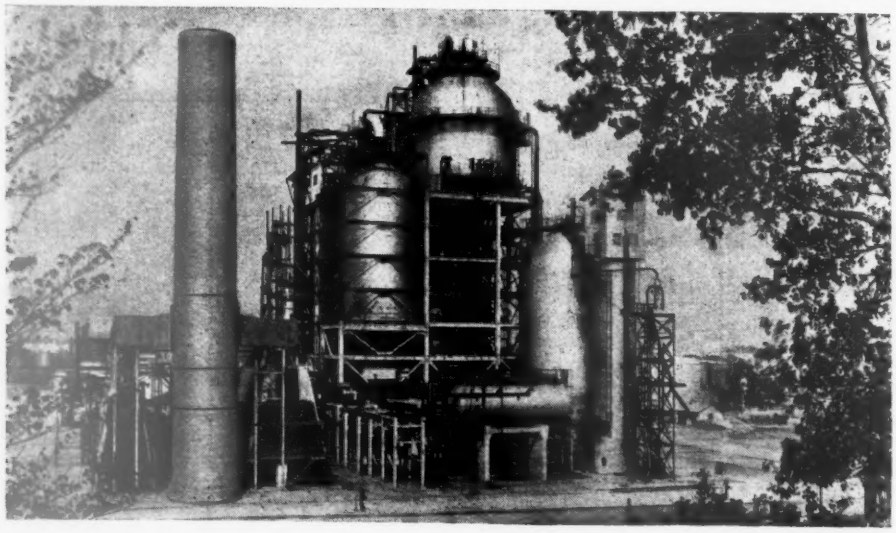
Method of Utilizing Graph Below

As Example A, when fuel is worth 60 cents per barrel and propylene and butylene are each assigned their F.O.E., the manufacturing cost for polymer is 2.65 cents per gallon.

As Example B, when fuel is worth $1.60 per barrel, propylene its F.O.E., and butylene 4 cents per gallon, the manufacturing cost for polymer is 6 cents per gallon.

MANUFACTURING COST FOR 1000 BBL. PER DAY CATALYTIC POLYMERIZATION UNIT





A postwar fluid catalytic-cracking unit—center of refinery operations at a Midwest plant. For its most profitable operation, the gaseous by-products should be further processed into additional gasoline.

casinghead gasoline for vapor pressure blending. As a result, refineries in these areas generally have available or can purchase a supply of isobutane at relatively low cost that can be processed with their normal excess of refinery B-B's (butanes and butylenes).

On the other hand, refineries in the Chicago and Eastern Seaboard areas generally do not have economical outside sources of natural gas or casinghead gasoline and must therefore rely on their own propylene and excess B-B's

SEALMASTER

TABLE 1

Economic study of alkylation vs. catalytic polymerization in representative areas. (Operation for 80 CFR-M gasoline.)

	Fixed amount of refinery butylene available; isobutane purchased for alkylation			Fixed amount of total B-B available; isobutane separated for alkylation	
	Case 1 Mid-Continent area	Case 2 Gulf Coast area	Case 3 Gulf Coast area	Case 4 Gulf Coast area	Case 5 Chicago or East Coast area
Value of isobutane, cents per gal.	2.5	3.0	1.0	F.O.E.	F.O.E.
Value of refinery fuel (F.O.E.) dollars per bbl.	0.50	0.60	0.60	0.60	1.92
Alkylation route					
Feed stock					
Fixed excess of refinery butylene, bbl. per day	775	775	775	585	585
Isobutane, bbl. per day	891	891	891	673	673
Total, bbl. per day	1666	1666	1666	1258	1258
Alkylate production, bbl. per day	1325	1325	1325	1000	1000
Value of alkylate					
Value of 80 CFR-M motor gasoline, cents per gal.	6.50	6.75	6.75	6.75	7.75
Lead credit for alkylate, cents per gal.	1.00	1.00	1.00	1.00	1.00
Total, cents per gal.	7.50	7.75	7.75	7.75	8.75
Manufacturing cost*, cents per gal.	4.20	4.80	3.40	3.40	7.00
Net return on alkylation, cents per gal.	3.30	2.95	4.35	4.35	1.75
Net return on alkylation, dollars per day	1836	1642	2421	1827	735
Polymerization route					
Feed stock					
Fixed excess of refinery butylene, bbl. per day	775	775	775	1258	1258
Propylene from fuel gas, bbl. per day	517	517	517	838	838
Total, bbl. per day	1292	1292	1292	2096	2096
Polymer production, bbl. per day	1000	1000	1000	1620	1620
Value of polymer					
Value of 80 CFR-M motor gasoline, cents per gal.	6.50	6.75	6.75	6.75	7.75
Lead credit for polymer, cents per gal.	0.70	0.70	0.70	0.70	0.70
Total, cents per gal.	7.20	7.45	7.45	7.45	8.45
Manufacturing cost*, cents per gal.	2.40	2.65	2.65	2.65	5.65
Net return on polymerisation, cents per gal.	4.80	4.80	4.80	4.80	2.80
Net return on polymerisation, dollars per day	2016	2016	2016	3266	1905

*Exclusive of depreciation and feed preparation charges.

TABLE 2

Economic study of alkylation vs. catalytic polymerization in representative areas. (Operation for 85 CFR-M motor gasoline.)

	Fixed amount of refinery butylene available; isobutane purchased for alkylation			Fixed amount of total B-B available; isobutane separated for alkylation	
	Case 1 Mid-Continent area	Case 2 Gulf Coast area	Case 3 Gulf Coast area	Case 4 Gulf Coast area	Case 5 Chicago or East Coast area
Value of isobutane, cents per gal.	2.5	3.0	1.0	F.O.E.	F.O.E.
Value of refinery fuel, (F.O.E.), dollars per bbl.	0.50	0.60	0.60	0.60	1.92
Alkylation route					
Feed stock					
Fixed excess of refinery butylene, bbl. per day	775	775	775	585	585
Isobutane, bbl. per day	891	891	891	673	673
Total, bbl. per day	1666	1666	1666	1258	1258
Alkylate production, bbl. per day	1325	1325	1325	1000	1000
Value of alkylate					
Value of 85 CFR-M motor gasoline, cents per gal.	7.50	7.75	7.75	7.75	8.75
Lead credit for alkylate, cents per gal.	1.15	1.15	1.15	1.15	1.15
Total, cents per gal.	8.65	8.90	8.90	8.90	9.90
Manufacturing cost*, cents per gal.	4.20	4.80	3.40	3.40	7.00
Net return on alkylation, cents per gal.	4.45	4.10	5.50	5.50	2.90
Net return on alkylation, dollars per day	2476	2282	3061	2310	1218
Polymerization route					
Feed stock					
Fixed excess of refinery butylene, bbl. per day	775	775	775	1258	1258
Propylene from fuel gas, bbl. per day	517	517	517	838	838
Total, bbl. per day	1292	1292	1292	2096	2096
Polymer production, bbl. per day	1000	1000	1000	1620	1620
Value of polymer					
Value of 85 CFR-M motor gasoline, cents per gal.	7.50	7.75	7.75	7.75	8.75
Lead credit for polymer, cents per gal.	0.35	0.35	0.35	0.35	0.35
Total, cents per gal.	7.85	8.10	8.10	8.10	9.10
Manufacturing cost*, cents per gal.	2.40	2.65	2.65	2.65	5.65
Net return on polymerization, cents per gal.	5.45	5.45	5.45	5.45	3.45
Net return on polymerisation, dollars per day	2289	2289	2289	3708	2348

*Exclusive of depreciation and feed preparation charges.

FOOTNOTES FOR TABLES 1 AND 2

1. The value of 80 or 85 CFR-M gasoline was placed at the average current figure for regular and premium gasoline respectively in the refining area concerned.
2. The lead credit for alkylate and polymer represents the added value above gasoline of these products in lowering the consumption of tetraethyl lead. For the 80 octane chart the refinery base stock was assumed to be 72.5 CFR-M clear octane, which could be brought up to 80 octane by the addition of 1.5 cc. TEL per gal. For the alternate 85-octane chart the refinery base stock was assumed to be 76 octane, which could be upgraded to 85 octane by addition of 2.5 cc. TEL. A blending octane of 93 CFR-M was assumed for both alkylate and polymer in determining their lead credits.
3. The total value of alkylate and polymer was taken as the sum of its value as 80 or 85-octane gasoline plus its lead credit.
4. In utilizing the correlation graphs to obtain manufacturing costs,
   (a) The value of isobutane adopted was either its F.O.E. or an arbitrary value that would permit economical manufacturer of alkylate. When an arbitrary value was assumed, it was based upon the availability of casinghead gasoline with associated butanes.
   (b) Fuel value was placed at the lowest cost of fuel encountered in the area concerned.
   (c) Butylenes and propylene were both considered as excess and computed at their F.O.E.

(above those used for vapor pressure blending) as the raw materials for processing into additional gasoline. The high cost of extraneous butanes in these areas tends to make their use as feed stock for alkylation economically unattractive.

● **Gulf Coast refinery can produce more alkylate than polymer.** Utilizing the original feed figures of the yields table, consider first a Gulf Coast refinery that daily produces 775 bbl. of B-B's in excess of the amount that can be blended into refinery gasoline. With such an excess, the total B-B pool would normally be of such size that the 775 bbl. could be recovered entirely as butylenes. The following table shows what can be accomplished with this excess by alkylation and by polymerization:

Comparative yields with 775 bbl. per day excess butylenes available.

	Alkylation, bbl. per day	Polymerization, bbl. per day
Feed		
Butylenes (from refinery)	75	775
Isobutane (purchased)	891	....
Propylene (from refinery)	....	517
Total	1666	1292
Yield	1325	1000

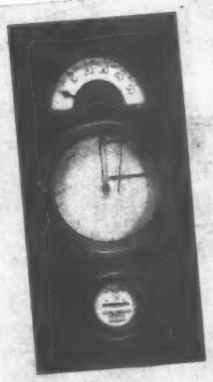
Via the alkylation route, 891 bbl. per day of low cost isobutane may be purchased and 1325 bbl. of alkylate produced—325 more bbl. of product to sell and blend than via the polymerization route.

● **Polymerization output greater on Eastern Seaboard.** As a second example and again referring to the original yields table, consider an East Coast or Chicago area refinery with a B-B excess pool of 1258 bbl. per day, which may be recovered either entirely as butylene, or partly as butylene and partly as isobutane:

B. t. u. Savers

FLOW METERS

Electrical Remote Reading Type



Republic electrical type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 10,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments—indicator, recorder and integrator—are of the remote reading type.

WRITE FOR DATA BOOK No. 701

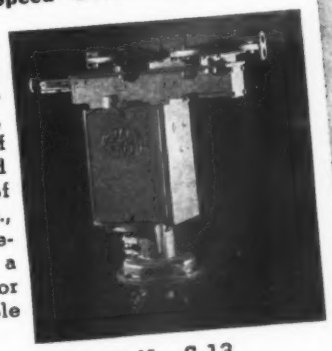
RECORDING THERMOMETERS

Republic thermometers are available for recording temperature of flue gas, temperatures in vats or tanks either open or closed and under pressure. For unusual conditions, special bulbs are furnished of corrosion resisting metal or with a protective coating.

WRITE FOR DATA BOOK No. 210

REGULATORS

Pressure—Flow—Speed—Level—Ratio



Republic hydraulic or pneumatic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.

WRITE FOR DATA BOOK No. S-13

PNEUMATIC TRANSMITTERS

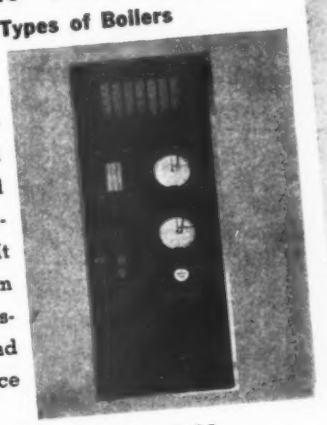
Operating On The Force-Balance Principle

Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables. These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

WRITE FOR DATA BOOK No. 1000

COMBUSTION CONTROL

For All Sizes and Types of Boilers

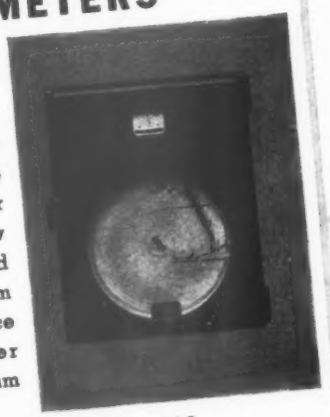


Republic automatic combustion control is available for all sizes of boilers, all types of fuel firing, all load conditions and any arrangement of draft equipment. It maintains constant steam pressure, highest combustion efficiency, desired load division, constant furnace draft.

WRITE FOR DATA BOOK No. S-21

BOILER METERS

Record Steam Flow-Air Flow



The Republic Boiler Meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion. The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

WRITE FOR BULLETIN No. 420

DRAFT AND PRESSURE INSTRUMENTS

For indicating and recording drafts, pressures and differentials, Republic dry-bellows type indicators and recorders are supplied for all ranges encountered in furnace operation, in any desired combination.

WRITE FOR BULLETIN No. 802.

Republic Flow Meters Co.

2240 Diversey Parkway — Chicago, 47, Illinois

The alkylation unit of a modern, Gulf Coast refinery. Its product, previously earmarked for aviation gasoline, is now utilized for upgrading motor fuel. Alkylate has an exceptional octane blending value.

Comparative yields with 1258 bbl. per day excess B-B's available.

	Alkylation, bbl. per day	Polymerization, bbl. per day
Feed		
Butylenes (from refinery)	585 } 1258	1258
Isobutane (from refinery)	673 }	..
Propylene (from refinery)	..	838
Total	1258	2096
Yield	1000	1620

This refinery, unable to purchase economically extraneous butanes, can produce only 1000 bbl. per day of alkylate; but via polymerization, by utilizing 838 bbl. per day of propylene from the fuel gas stream, 1620 bbl. per day of polymer can be obtained.

● **Operating costs higher for alkylation than for polymerization.** Of course yield comparisons must be considered with operating and raw material costs before any economic conclusions can be drawn. The general costs of catalyst, chemicals, labor, maintenance, and royalties are approximately 30 per cent higher for alkylation than for polymerization. In addition to this fairly constant differential there is a wide variation in the amount of utilities consumed by each process. Because of the nature of the process, alkylation requires refrigeration and a fairly high degree of gas recycling, whereas polymerization is essentially a once-through catalytic operation requiring less pump and motor capacity. As the cost of all utilities stems directly from the cost of fuel, it follows that the direct operating cost for either process (exclusive of depreciation) can be correlated with the value of fuel oil. The graph, Fig. 1, shows the operating costs for alkylation and polymerization as a function of fuel value.

It is apparent that alkylation direct operating costs are substantially higher than polymerization costs and that the differential between the two processes increases with increasing cost of fuel.

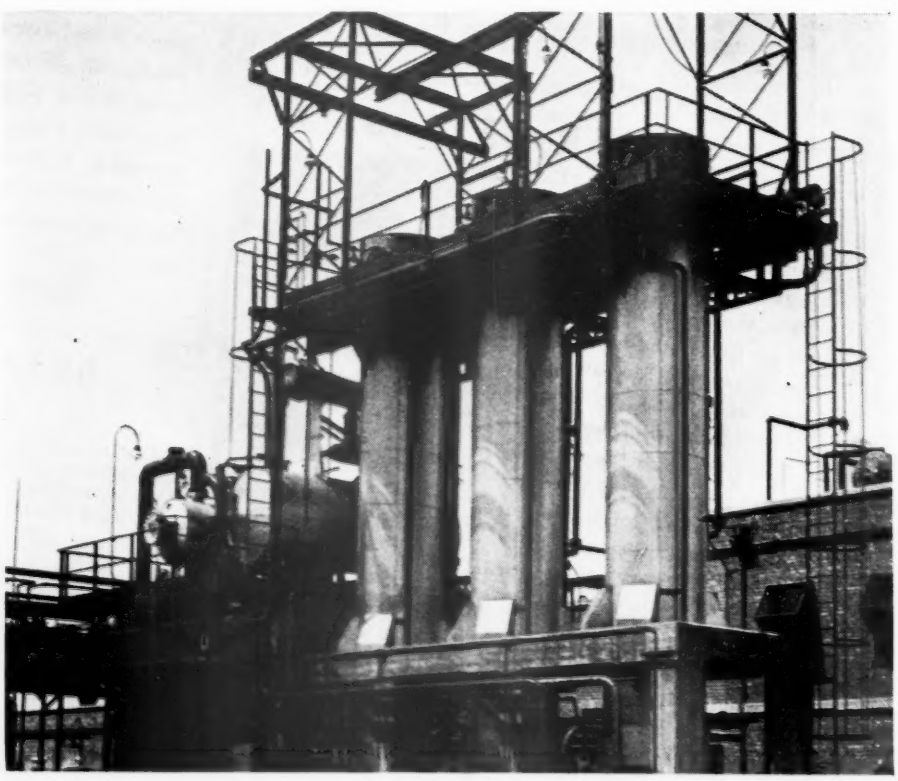
● **Direct manufacturing cost depends on three variables.** Direct manufacturing cost (the sum of direct operating cost and the cost of raw materials) is the factor that finally determines the relative desirability of processing methods. Having reviewed operating costs for the two processes there remains the factor of raw material costs.

Although propylene may be used as the starting material for a host of chemical compounds, generally speaking, in the average refinery (unless it is polymerized) it is burned as fuel and so may be considered at its fuel oil equivalent value (that is, its relative value as a fuel compared to liquid fuel oil). A portion of the refinery B-B's assume the value of the gasoline into which they are blended but excess B-B's, including isobutane and butylene, are of value only as fuel unless further processed or sold. Replacement costs of extraneous butanes sometimes determine the value of isobutane and butylene in a given refinery situation.

Direct manufacturing cost then becomes primarily a function of three variables—the value of fuel, the value of isobutane, and the value of butylene.

● **Simple calculating method for quick estimation of manufacturing cost.** Because of this triple dependency the estimation of manufacturing costs is ordinarily a time-consuming statistical

Reaction and recovery towers of a catalytic polymerization unit at a Midwest refinery. The feed gases (buytlene and propylene) are passed over a solid catalyst to form a polymer with slightly lower octane blending value than alkylate.



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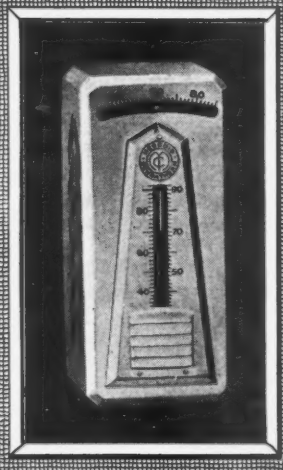

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FOR INDUSTRY

task, but by converting the results obtained at a large number of operating units to a multi-component nomograph, Kellogg economists have simplified this calculation considerably. A brief application of price structure to the two charts in Fig. 2 is all that is necessary to determine manufacturing costs for alkylation and polymerization. Although these graphs have the common limitation of all generalizations in that they do not eliminate the necessity for detailed, individual refinery economic analyses, it is felt that they provide good approximations of manufacturing costs under a wide variety of conditions. They have been prepared so that almost any refiner in this country can apply his own price structure and so determine manufacturing costs in his area for the alkylation and polymeriaztion processes.

● **Five-refinery economic study for 89 and 85-octane gasoline production.** To complete the appraisal, we have applied this method of computing manufacturing costs for alkylation and polymerization to five hypothetical but representative refineries in this country. Two economic studies have been prepared—one based on operation for 80 CFR-M motor gasoline and the other for 85 CFR-M motor gasoline. The data are summarized in Tables 1 and 2 and reflect the conditions prevailing in operating units today.

At the 80-octane level it is apparent that the economic advantage of either process rests with the cost of isobutane. Only in Case 3 (the Gulf Coast), where isobutane is assumed to be available at 1 cent per gal., does alkylation appear the more attractive step economically. In Cases 1 and 2, a higher price for extraneous butanes shifts the advantage of polymerization.

In Cases 4 and 5 where extraneous butanes are normally not available, the economic advantage of polymerization over alkylation is unmistakable.

The studies show, however, that at the 85-octane level, the relative returns from alkylation are substantially greater in every case than they were at the 80-octane level. For instance even at the 3-cent isobutane cost of Case 2, the net return on alkylation is almost equal to that of polymerization ($2282 vs $2289). And at the 1-cent isobutane level alkylation yields an annual net return of 33 per cent or $280,000 more than polymerization. If octane quality above 85 were required, alkylation would continue to show an increasingly favorable monetary differential over polymerization.

By increasing gasoline yields, alkylation and polymerization both conform admirably to the refining industry's own desire to conserve petroleum. In addition, both are well adapted to meet the future challenge of higher octane motor fuel; however, the commercial application of any process, regardless of improved results, must be justified on an economic basis. If the above discussion has served to throw a little light on the relative economics of these two processes in present-day refining, then its purpose will have been realized. ★★★

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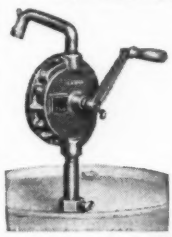

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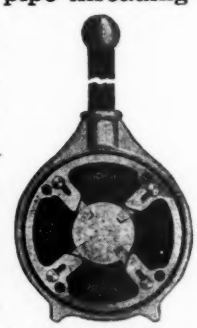

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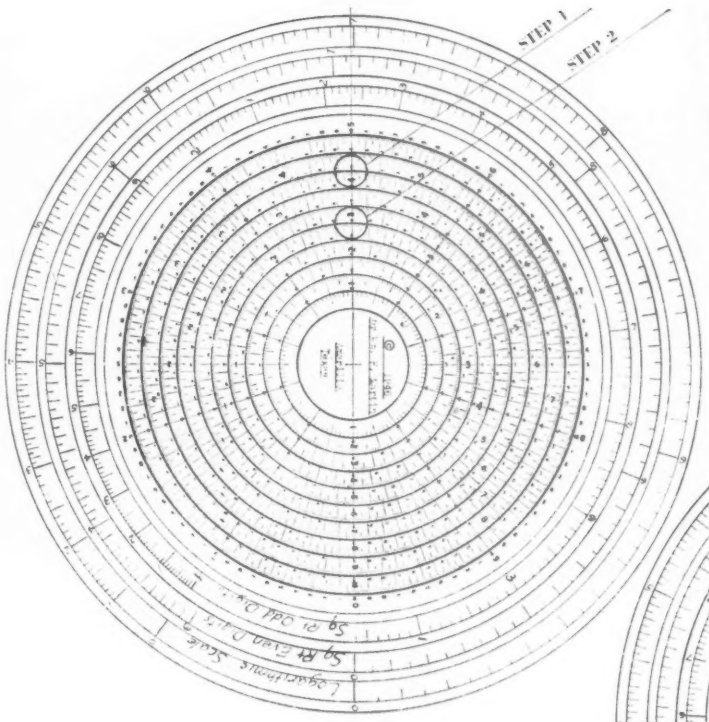
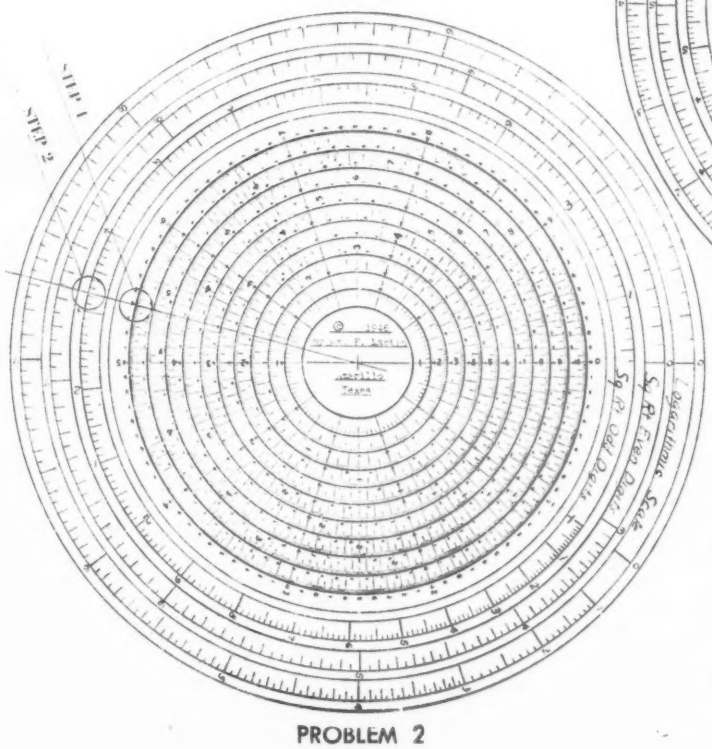
General purpose calculator

By **W. F. MARTIN,** Texoma Natural Gas Company

PROBLEM 1





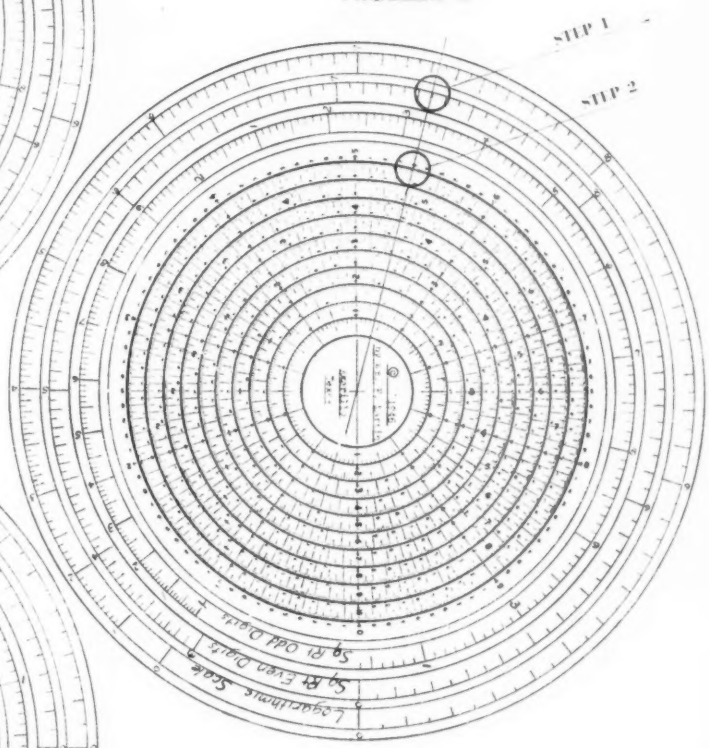
PROBLEM 2

THE calculator illustrated herewith is constructed to give direct readings of fractions, square roots, and logarithms, as well as anti-logarithms. It is also a circular multiplication table. To multiply by a figure of numerous digits, it is necessary to pick off the amounts for each digit of the multiplier and add them. In this respect, it is not as handy as a slide rule of an alignment chart, but in other respects it is superior.

EXCLUSIVE

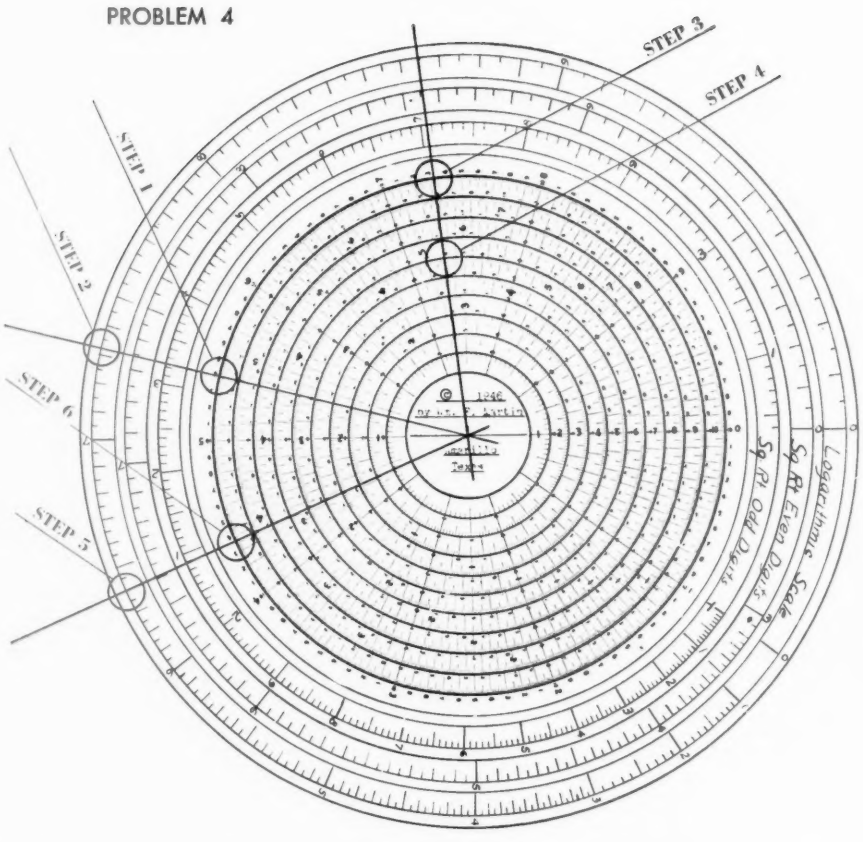
The device is equipped with a transparent arm pivoted in the center, on which is drawn a center line, and on which are necessary identifications for circular columns, such as 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10; square root scale for odd digits; square root scale for even digits, and logarithms.

PROBLEM 3



A handy device from which to obtain anti-logarithms is something that is badly needed, and I believe this device fulfills such need. In designing special charts, logarithms are used extensively. It is not difficult to refer to a table for a logarithm, but such table is not handy for an anti-logarithm.

Examples follow:



Problem No. 1: We require $\frac{5}{8}$ of 400. Step 1: Place C/L of arm on "4" in the "8" column. Step 2: Read 250 in the "5" column. If we wanted $\frac{3}{8}$, we would simply drop down to the "3" column and read the answer. One movement of the arm solves the problem.

Problem No. 2: We require the square root of 5.4. Step 1: Place C/L of arm on 54 in the "10" column. Step 2: Read square root in the "Sq. Rt. Odd Digits" column. This is 2.324.

Problem No. 3: We require the square root of 54. Step 1: Place C/L of arm on 54 in the "10" column. Step 2: Read square root in the "Sq. Rt. Even Digits" column. This is 7.35.

Many people have occasion to use square roots who are not familiar with logarithms, hence the square root scales.

Problem No. 4: We require $540^{.6}$. Step 1: Place C/L of arm on 54 in the "10"' column. Step 2: Read log. mantissa in the "Logarithm" column. This is 0.7324. The characteristic is 2. Log. of 540 is 2.7324. Step 3: Place C/L of arm on 7324 in the "10" column. Step 4: Read 0.6×0.7324 in the "6" column. This is 0.4395. The characteristic of 2 multiplied by 0.6 is 1.2. 1.2 plus 0.4305 is 1.6395. Step 5: Place C/L of arm on 6395 in the "Logarithm" column. Step 6: Read anti-log. in the "10" column. This is 4360. As the characteristic is 1, our answer is 43.60.

★ ★ ★

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Blowout subdued under difficult conditions

By **RICHARD SNEDDON,** *Pacific Coast Editor*

EXCLUSIVE

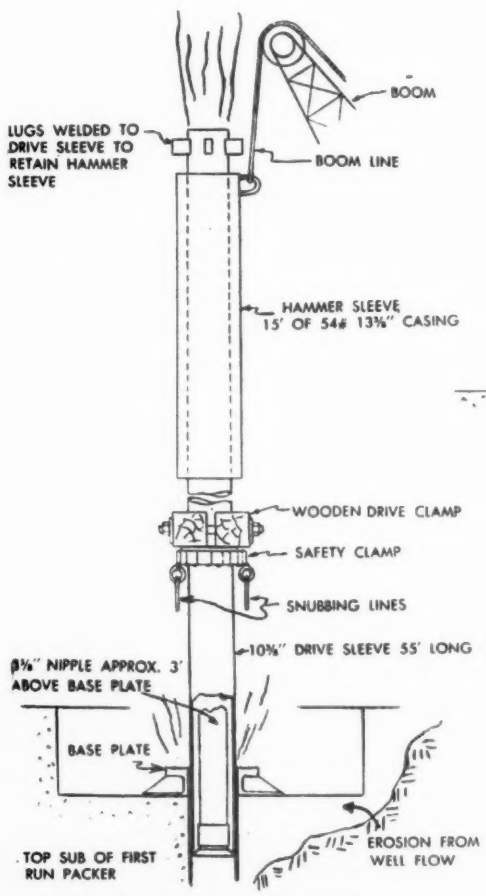
An interesting and somewhat exciting piece of engineering is revealed in connection with the control of a blowout on the R. E. Havenstrite Barnes No. 1 well at Del Valle, on August 15. Examination of the well indicated that the annulus between the 11¾-in. surface string and the 7-in. oil string had built up a pressure that had caused the surface equipment to fail. This failure began with a leak that developed in the weld securing the base unit to the surface string, and quickly cut out the side of the base unit. In a short time it had also cut out the christmas tree and suspension parts supporting the 7-in. casing at the surface. The remaining portion of the christmas tree had been removed from the well by the crew, and all surface fittings had been stripped down to the base plate.

A control plan was developed by Russell Havenstrite and his immediate aides, Homer Havenstrite, Ed McWherter, John McWherter, and Doc Miller, with Glenn Johnson, chief engineer of Baash-Ross Tool Company, doing the advisory honors and engineering the special equipment that was required to complete a distinctly strenuous job. It was decided to use a packer in the form of an inverted hangar of such a size that it could be passed down over the 7-in. casing, which was still in the well, and inside the 11¾-in. casing, sealing in the latter.

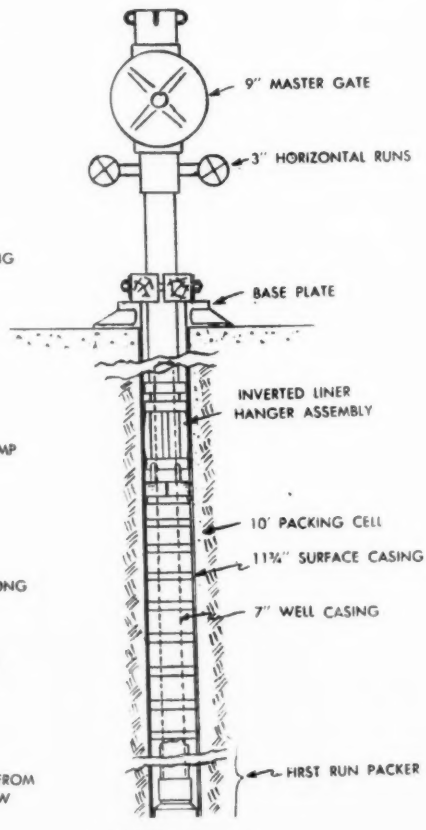
An 8⅝-in. casing nipple was to be screwed into the upper end of the inverted liner hanger, and was to receive a 9-in. 6000-lb. test gate valve at its lower end. Two 3-in. horizontal runs were to be arranged immediately below the 9-in. gate valve, to serve as a communication to the well when the former was closed. The 8⅝-in. nipple, to be used for spacing the gate valve above the inverted liner hanger, was approximately 10 ft. long, and was designed to position the packer about 12 ft. below the base plate. This assembly was made up at the Baash-Ross plant, under the supervision and direction of Glenn Johnson, and when finished was taken out to the well.

Meantime, a Pacific Crane and Rigging Company 60-ft. boom crane had been dispatched to the well to be employed in installing the equipment as described. The packer assembly was picked up by the crane and lowered into the well. In stabbing the arrangement into the well, four guy lines were attached to the lower end of the packer to assist in stabilizing it over the slip stream, and two snubbing lines were fastened to the upper end of the packing assembly, the latter passing downward through snatch blocks attached to eyes grouted in the cellar. The snubbing lines, after passing through the snatch blocks, were connected to the crane winch. To insert the packer, it was first hoisted into vertical position, was then guyed into the slip stream until it was directly over the hole and, as the boom line was paid off, the snubbing lines pulled the packing assembly into the well. Despite the fact that the well was geysering more than 65,000,000 cu. ft. of wet gas with a mixture of sand, rotary mud, and water, the stabbing operation was performed without incident, other than some difficulty that was experienced in passing the packer down over the 7-in. casing, the upper end of the latter being about 3 ft. below the base plate.

After the packer had been inserted to depth, the hold-down slips were released, and assembly elevated to expand the packing in the 11¾-in. casing, and the 9-in. gate valve closed. It was then discovered that the 11¾-in. casing had been cut out to a point even below the point of seal, which was approximately 12 ft. below the base plate, and in order to control the well it would be necessary to remove the packer and to add sufficient nipple length between the packer and the valve assembly to set the packer at a lower depth. It was thought, too, that rubber should be used in substitution of lead as a sealing means in the second packer and to increase the length of the packing cell in order to afford a


BOOM
LUGS WELDED TO DRIVE SLEEVE TO RETAIN HAMMER SLEEVE
BOOM LINE
HAMMER SLEEVE 15' OF 54# 13⅜" CASING
WOODEN DRIVE CLAMP
SAFETY CLAMP
SNUBBING LINES
10⅜" DRIVE SLEEVE 55' LONG
8⅝" NIPPLE APPROX. 3' ABOVE BASE PLATE
BASE PLATE
TOP SUB OF FIRST RUN PACKER
EROSION FROM WELL FLOW

Driving arrangement used to reposition first packer.



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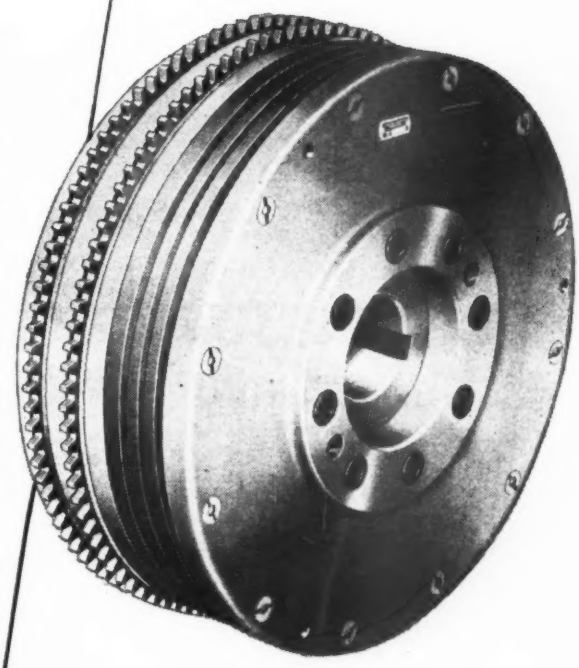

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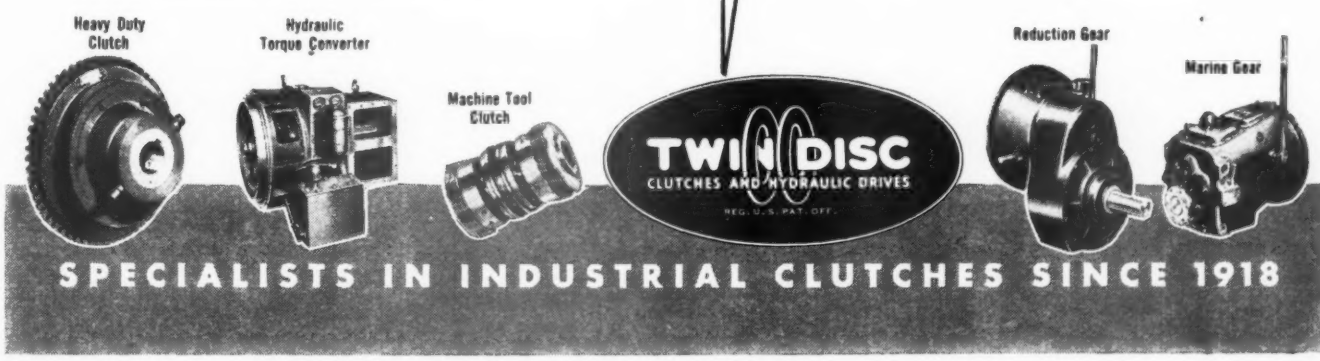

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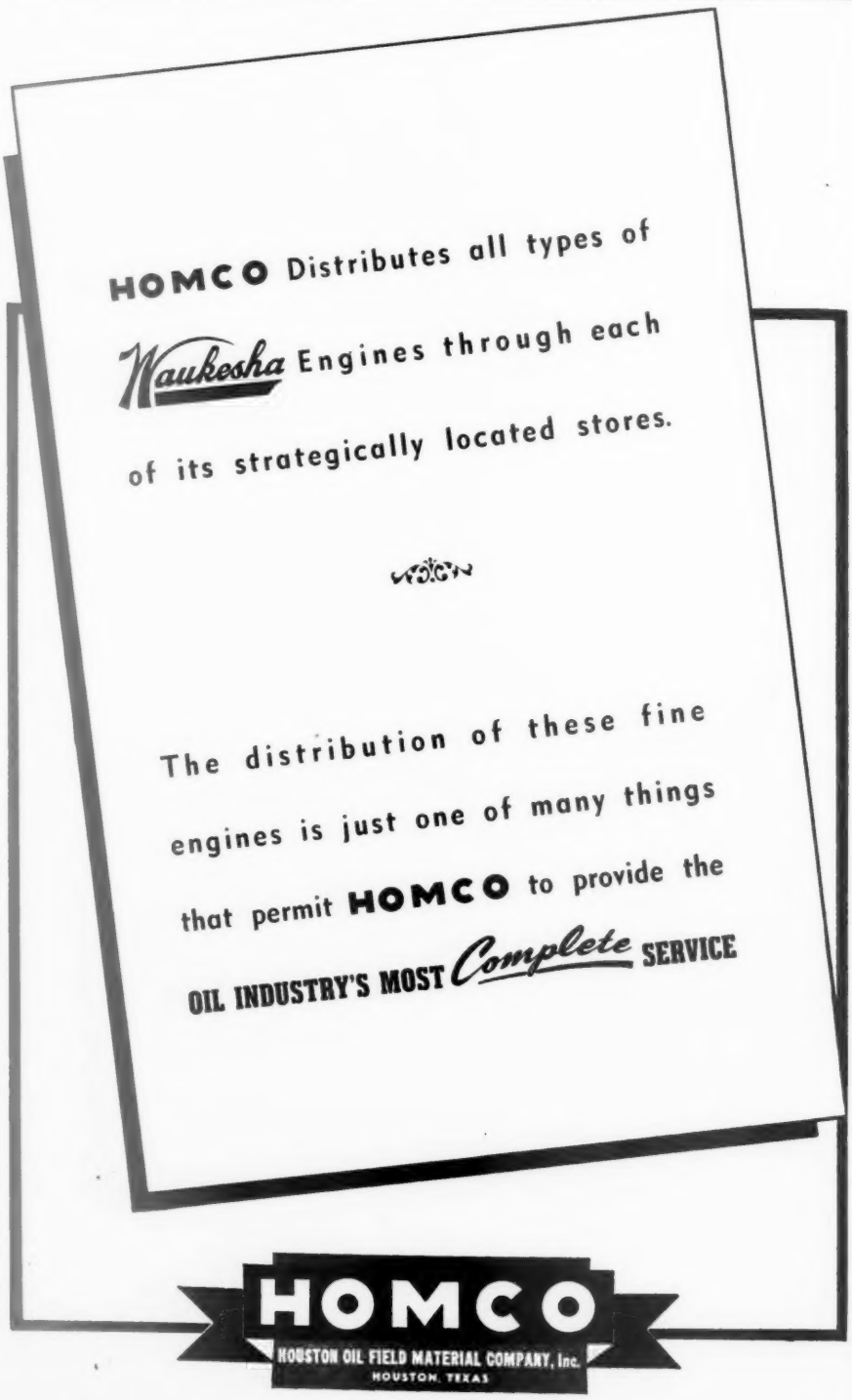
better chance of sealing in the 11¾-in. casing.

The first run packer was left in the well to protect the 11¾-in. casing as much as possible while the special packer was being constructed. When the second packer was finished an attempt was made to remove the first packer. It was then discovered that the releasing mechanism had been sand cut and eroded to such an extent that the slips could not be released and the packer was bulldogged in the 11¾-in. casing. Every conceivable means was used in an effort to remove the first run packer without success and erosion of the gas flow finally weakened the upper end of the 8⅝-in. nipple to a point where the valve assembly, which included the 9-in. valve and horizontal fittings, was blown off. Fortunately for the workers the boom line was left attached to the valve assembly and blown from the well. It was not thrown too great a distance into the air and did not fall on any of the workers who were at the well at the time. The 11¾-in. guide sleeve that was used in stabbing the packing assembly into the well, and which was around the 8⅝-in. nipple supporting the valve assembly above the base unit, was hurled more than 300 ft. in the air and disappeared over an adjacent hill when the explosion occurred.

It was discovered upon inspection that the packer had not moved during the explosion and that approximately 4 ft. of the 8⅝-in. nipple was left extending above the base plate, and that most of the flow was being confined to the upper extending 8⅝-in. nipple. Inasmuch as previous efforts had failed in an attempt to remove the packer, it was then decided to try to move the packer far enough down into the well so that the new packer could be set at a point above. To accomplish this, a driving sleeve 45 ft. long was passed downward inside the 11¾-in. casing and over the 8⅝-in. nipple to contact the upper packer sub, interconnecting the packer body and 8⅝-in. nipple. A safety clamp and hardwood driving clamp were fastened to the driving sleeve so that it would be positioned above the base plate when the sleeve was inserted in the well. A 15-ft. length of 13⅜-in. casing was then telescoped over the upper end of the driving sleeve and projections were welded to the upper end of the latter so that the telescopic sleeve would have limited longitudinal movement between the wooden drive clamp and the upper end of the drive sleeve. An eye was welded to the upper end of the telescopic sleeve and received by the boom line. When assembled, the entire unit was hoisted by the boom line and stabbed into the well in the same manner as was the original packer. With the snubbing lines holding the drive sleeve down on the upper packer sub, the telescopic sleeve was raised and dropped on the wooden drive clamp much in the same manner as a pile driver, which caused the packer to be driven downward into the well to a point below where the second packer was to be set. The drive sleeve was left in the well to protect the 11¾-in. casing while the second packer was being made up on the lower end of the 30-ft. spacer nipple and while the manifold assembly, including the 9-in. gate valve and side arms, was assembled to the upper end of the spacing nipple. When this assembly was made up, the drive sleeve was removed from the well and an attempt was made to stab the second packer. The slip stream was violent enough to cause the displacement of the rubber packing rings and it was impossible to stab the packer into the well.

At this stage of operations it was necessary to do something and in short order, as the 11-¾-in. casing was exposed to erosion and would, in a short time, cut out at the point where the packer was to be set. In order to save time the packer was laid down and the displaced rubbers were re-assembled in their proper place and the entire 10-ft. packing cell was spirally wrapped with black friction tape to encase not only the packing rubbers, but the metal spacer rings as well. The second packing assembly was then picked up and stabbed in the well, was rotated to release the slips, elevated slightly to cause the rubbers to expand and seal off in the 11¾-in. casing, and the valves were closed, which completely shut in the well.

★ ★ ★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Rehabilitation in

The Netherlands East Indies oilfields

By their attack on Pearl Harbor in December, 1941, the Japanese automatically cut themselves off from their main sources of oil supplies in the U.S.A., and the N.E.I. They had, of course, expected such a situation and had in anticipation built up certain stocks of crude oil and products, as is borne out by the following figures for production, imports, and consumption of crude oil and derivatives in Japan in the pre-war years.

In metric tons	Production	Imports	Consumed	Excess over imports
1929		1,393,000	1,723,000	— 330,000
1937	362,000	4,770,000	4,742,000	+ 28,000
1938	368,000	5,800,000	3,749,000	+2,051,000
1939		5,100,000	4,044,000	+1,056,000

The solution was obvious. The U.S.A. was far away and unassailable, hence they looked to the East Indian Archipelago as a potential source of supply for the needs of their war machine.

These countries, however, were prepared. As it was evident that the rich oil fields of Miri and Seria, on the northwest coast of Borneo could not be defended against the overwhelming force that Japan in its first attack was expected to employ and actually did employ, the manager of the Sarawak Oilfields, Ltd., an associated company within the Royal Dutch Shell Group, called his staff together on December 8, 1941, to announce the decision of the British Government to sacrifice the work of decades: To destroy the refinery and oilfields in Sarawak and British Borneo.

The work of destruction was carried out with grim determination by men, all of whom had helped to build the vast complex of wells, connections, pipe lines, gathering systems, storage and refining equipment, and it is needless to say that it was done with sad hearts.

In one week the work was completed and when the Japanese entered Miri by the middle of December, 1941, they found only the ruins of what once had been a flourishing industry.

The next target was the island of Tarakan, lying off the northeast coast of Borneo and belonging to the Netherlands East Indies. All preparations had been made and the attack on January 10, 1942, was not unexpected. The Dutch garrison defended the island in a man to man fight but was helpless against the overwhelming majority of the enemy and therefore the order for destruction previously prepared was given. Approximately 400 producing wells were destroyed by explosives and by dropping the tubing in the holes and the pumping equipment was blown up. When the attack was under way in the night of the 10th to the 11th of January, 1942, all tanks were destroyed and with them some 100,000 tons of oil. No tank remained standing.

The effectiveness of the destruction can be judged by the rage of the Japanese when their experts inspected the wells and found them destroyed. They sent a message to Balikpapan, threatening all the European inhabitants with death in case oil installations should be destroyed.

After the fall of Miri, Seria, and Tarakan the next move of the enemy was directed against the important oil center of Balikpapan, on the east coast of Borneo. Notwithstanding the warning, Balikpapan was destroyed on January 22, 1942, when a large enemy fleet was reported to be approaching. The small oilfield at Boela, on the island of Ceram, followed on or about January 30 and also at about the same time, the oilfields and the Babo operations center in New Guinea.

The oilfields in the South Sumatra area tributary to the Pladjoe Refinery were destroyed on February 14, 1942, after the Japanese had dropped paratroops on the Pladjoe refinery. Shortly afterwards the installations at Pangkalan Brandan and Pangkalan Soesoe, in North Sumatra, and the Java refineries at Tjepoe (Rembang) and Wonokromo (near Soerabaya) were also destroyed.

It is beyond the scope of this article to dwell upon the human suffering that was caused by the ruthless attacks on these formerly peaceful settlements, but it can well be imagined from the now known figures that 25 per cent of the staff employed at the outbreak of hostilities were killed, died, or are missing.

What the destruction means in value can at the present time only be very roughly estimated.

The stocks of crude oil and products destroyed at the outbreak of hostilities in the East Indian area can be estimated at 1,000,000 kgt. Adding to this an estimated figure of 9,000,000 kgt. brought to the surface by the Japanese, during their 3½ years of occupation, the total loss can be set at 10,000,000 kgt.

Japanese activities during the time of occupation are not yet fully known. It is clear, however, that the Japanese were well prepared to take over the oil industry. According to reports, some 150 drilling outfits were brought into the region.

A brief outline is given below of what is at present known of each oil area in the East Indian Archipelago.

● **Seria and Miri.** The Seria and Miri oilfields were recaptured from the Japanese in July, 1945. The enemy in his retreat had fired the flowing wells at Seria and blown up all major installations. By the end of September, 1945, all fires had been extinguished and rehabilitation in the fields was proceeding, while reconstruction of the badly damaged refinery at Lutong had begun. Drilling was resumed early in 1946 and regular shipment of crude oil from the area began in March, 1946. Present daily production is 10,600 bbl., which is expected to increase substantially by the end of the year.

● **Tarakan.** This island lying off the east coast of Borneo produced, before the war, 2000 metric tons of crude oil daily from 580 wells. The characteristics of the oil are such that it can be used as diesel or under boiler fuel after a simple dehydrating process.

The Japanese drilled 173 new wells. The amount of oil extracted by them is not known. One estimate sets it at 800,000 cu. m. After the recapture of the island in May, 1945, the field appeared to have been destroyed by the Japanese occupation forces, before surrendering. Repairs began immediately after the reoccupation and production was resumed as early as June, 1945. By the end of 1945, 255 wells were ready to be put into production. The scarcity of material and supplies hampered speedy rehabilitation. It is hoped, however, that it will be possible to increase the storage and pumping facilities to such an extent that by the end of 1946 a quantity of 30,000 metric tons, or 50 per cent of the prewar figure, can be handled.

● **Balikpapan.** The refinery at Balikpapan (on the east coast of Borneo) was destroyed on January 22, 1942, by the Dutch, when there was no chance of holding their position against the advancing Japanese. A thorough job was made of it and it took the Japanese a long time before they were able to put part of the apparatus into operation again.

When, in 1945, the Allied troops recaptured the area, the Japanese in turn destroyed everything they had rebuilt that had escaped Allied bombing.

The Balikpapan refinery was a complete plant with a crude charging capacity of 6000 metric tons daily. It included a wax plant and lubricating oil plant and such auxiliaries as drum and can making factories. All these installations were put out of action and it is evident that the reconstruction will take much time. One crude oil pipe distilling

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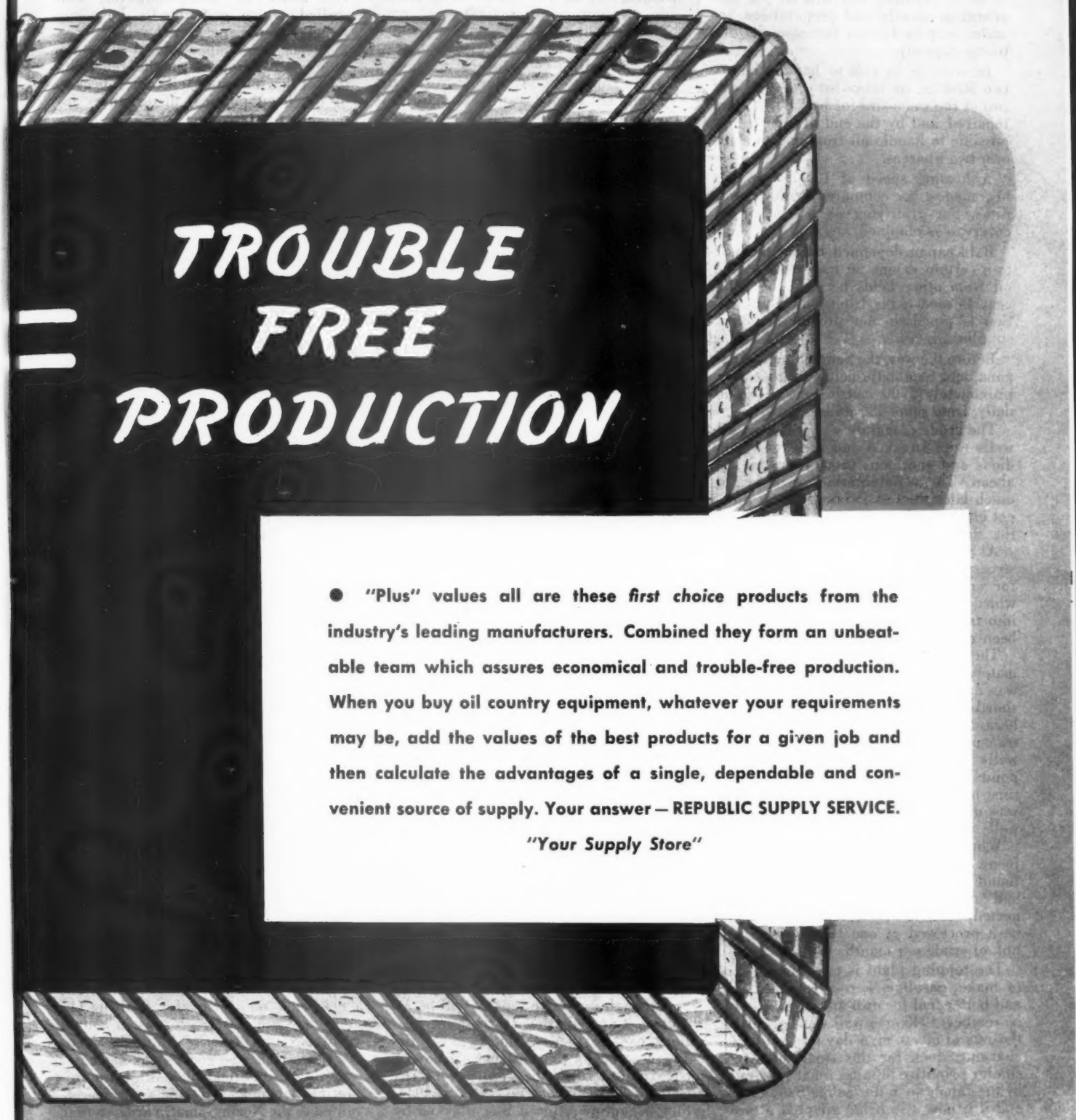

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unit, with a capacity of 600 metric tons per day, has been repaired and is operating. A second unit of the same capacity is being repaired and will be put into operation shortly and preparations are under way to further increase the distilling capacity.

In order to be able to handle the oil, two 5000 cu. m. tanks for diesel oil and two of the same size for boiler fuel were repaired and by the end of May it was possible to handle oil from and to ships over two wharves.

A loading speed of 100 cu. m. per hr., modest as compared with prewar rates, but gratifying as a sign of recovery, was obtained.

Balikpapan depended before the war to a certain extent on imports of crude oil from other fields because the adjacent Borneo fields from which production is piped do not provide sufficient supplies of crude.

Before the war, the Sanga Sanga, Anggana, and Sambodja fields produced approximately 2500 metric tons of crude daily, from some 450 wells.

The crude is mainly waxy. Almost all wells were wrecked and therefore a tedious and enormous task of repair lies ahead. The rehabilitation work began much later than at Tarakan but at present eight repair crews are rehabilitating the damaged wells.

At Sanga Sanga the Japanese had constructed three large earthen reservoirs for crude oil storage, the contents of which are now gradually being pumped into tanks. A total of 35,000 cu. m. has been recovered in that way.

The Tandjoeng field, situated approximately 200 km. southwest of Balikpapan, was undamaged. This field was opened shortly before the outbreak of war and because facilities for gathering and transporting oil from the eight flowing wells to the nearest refinery or shipping point had not yet been erected at the time of the Japanese invasion the field was of little use to the Japs, and the wells were left intact.

When the Dutch returned to Tandjoeng after the Japanese surrender, they found that a make-shift topping plant had been constructed. From disconnected data it appears that the Japanese processed at one time some 1000 bbl. of crude per month.

The topping plant is now being used to make gasoline, kerosine, diesel oil, and boiler fuel for own and local use. In November, 1945, one well was flowing at the rate of 50 cu. m. a day to supply the charging stock for this small plant. A similar primitive topping plant was built by the Japanese in the Sanga Sanga field and it is now also being adapted to produce gasoline, kerosine, and diesel oil.

● **Ceram.** Information concerning the small fields on the island of Ceram, Boela and Lemoen, is at present unavailable. The prewar production amounted to nearly 300 metric tons of oil a day. The remoteness and comparatively small importance of Ceram compared with the pressing needs of other areas have been the reasons that the rehabilitation work could not be taken in hand earlier, but it is expected that news of Ceram will be forthcoming soon.

● **Dutch New Guinea.** In Dutch New Guinea, one of the world's most intensive exploration campaigns was embarked upon in the 30's by the Nederlandsche Nieuw Guinee Petroleum Maatschappij, a company in which the Royal Dutch Shell, the Standard-Vacuum Oil Company, the Standard Oil Company of California, and The Texas Company are interested.

Before the outbreak of World War II, three fields, namely, Klamono, Wasian, and Mogoi, had been discovered in the so-called Vogelkop portion of northwestern New Guinea.

Before the New Guinea areas were captured by the Japanese, as much as possible was done to render these developments useless to the enemy and because of the remoteness of this region information on the present condition of the fields is extremely fragmentary. It is not supposed, however, that the Japanese had made any serious effort to produce the three New Guinea fields.

At the present time vigorous preparations are being made to resume operations in New Guinea.

● **South Sumatra.** The Pladjoe refinery is situated on the south bank of the Moesi river near the town of Palembang and alongside the Soengei Gerong refinery of Standard Vacuum. On February 14, 1942, the Japanese launched an airborne attack on the Pladjoe refinery that resulted in the loss of this plant after a brief but fierce struggle. As Japanese paratroopers were dropped in the Pladjoe refinery area, the prearranged demolition program could not be carried out as planned and only improvised measures could be taken. As a result the destruction of this refinery was not so complete as that of the others.

The prewar crude distilling capacity was about 8000 metric tons daily, and was, according to the last available report, reduced to 3500 metric tons.

The refinery was a complete one and consisted of a cracking unit of 1000 metric tons daily total intake, two Edeleanu plants, one for gasoline and one for kerosine, and two reforming plants for gasoline reforming with a daily intake capacity of 1000 metric tons each. There were also a vacuum distilling plant of 1800 metric tons daily intake capacity, and an isooctane and alkylation plant.

Although extensive repairs will be required, it appears that all these installations can be used again. In 1943 the Japanese began to construct a Knowles coke plant, which they finished in December, 1944. When, in January, 1945, they began operation it was attacked by Allied bombers, which put the installation out of action.

The oilfields were put out of commission according to prearranged plans. The Japanese, however, prepared as they were, succeeded in the comparatively short time of one year in restoring production to some extent. It has not yet been possible to investigate the condition of the wells in this region so that it is not known whether or not the Japanese obtained a high rate of production by indiscriminately opening up the flowing wells without regard to ultimate recovery. Some 60 wells, however, were drilled, which undoubtedly have contributed to the speedy recovery.

It has been impossible to make any appreciable progress in the rehabilitation of this important oil center, because of the local political disturbances fostered by the Japanese.

● **Pangkalan Brandan.** The refinery at Pangkalan Brandan is situated on the Babalan estuary on the northeast coast of Sumatra. It is equipped with two crude oil distilling units with an aggregate capacity of 3000 metric tons daily. It also contains a gasoline Edeleanu plant, but no cracking facilities. The refinery, as well as the fields, were demolished when the Japanese approached in 1942, all according to the prearranged plans. No details, however, have become available regarding the extent of the demolition. According to reports received from Japanese sources, one pipe distilling unit of a capacity of 2000 metric tons of crude daily was still usable, although it was partly destroyed in an Allied bombardment in January, 1945. The Japanese then attempted to transfer two furnaces and one fractionating tower with which to erect a topping unit of 500 cu. m. daily capacity at Sawit Sebrang. They also erected at Langsa a small 2-stills topping unit of 36 cu. m. crude oil capacity daily. The gasoline Edeleanu plant is reported to be destroyed beyond repair. The tank installations at Pangkalan Brandan and the terminal, Pangkalan Soesoe, situated at 15 km. distance from the first named locality, had a prewar capacity of around 400,000 cu. m. Here a great number of the larger tanks have been destroyed by allied bombing and the total storage capacity is now about 150,000 cu. m.

Figures about the quantity of crude oil produced and processed by the Japanese are very incomplete. The principal production seems to have been obtained from the prolific Rantau field; and the comparatively new field, Paloeh Taboehan, was tapped rather intensively by the Japanese. It is estimated that they extracted from all fields in the North of Sumatra some 1,400,000 cu. m. of crude oil.

Apparently they found some time for wildcatting, as one well was sunk near Tandjong Poera (near Pangkalan Brandan) and one near Iee Tabeu (in Acheen), and a well site was in course of preparation near Belawan, the deep-sea port at the east coast of Sumatra.

Owing to political difficulties, the operating personnel have not yet been admitted to the North Sumatra area, so that it has been impossible thus far to check the accuracy of the above information.

● **Java.** On Java, a very densely populated area, the Royal Dutch Shell had one refinery at Tjepoe, near the small port of Rembang, and a refinery of limited capacity at Wonokromo, near the port of Sourabaya. The refinery at Tjepoe consisted of two crude oil distilling units, one pipe still unit, and one continuous still battery; also a cracking

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plant, a wax plant, and candle factory. The throughput amounted, in prewar days, to about 1000 metric tons of crude daily.

According to unchecked information, the above-mentioned pipe still unit was restored by the Japanese in 1943, but the condition was very bad, and the continuous still battery, which was destroyed by the Dutch before the Japanese took possession, was not rebuilt.

Before the war the fields in this region produced some 2000-2500 cu. m. of crude oil daily, which was considerably more than required as charging stock for the Tjepoe refinery. The excess was shipped elsewhere for processing. It is reported that the Japanese reverted to this practice when the fields were put into production again. In the Kawengan field there appear to have been three steam-driven drilling rigs working but no information is available as to the number of wells drilled. A very rough production estimate based on unchecked information was drawn up. This places the total crude oil obtained by the Japanese from the Rembang fields in the years 1942 up to their capitulation in 1945 at 1,500,000 cu. m.

The refinery at Wonokromo consisted of one crude oil pipe distilling unit of about 300 metric tons daily intake capacity. This unit has completely disappeared. Reports suggest that it was transferred by the Japanese to a village inland. It is, however, more likely that this plant was destroyed by Allied bombing. There was and still is intact a small asphalt plant with a production capacity of some 75 kg. tons of asphalt daily. The auxiliary plant of the refinery is badly damaged.

The fields that supplied the feedstock of the refinery, Kroeka and Lidah Koelon, have been found in reasonably good condition. The Japanese apparently succeeding in repairing the Kroeka field and by drilling 14 new wells they obtained from the entire Sourabaya area about 250,000 cu. m. of crude oil.

● **Summary.** Having thus given a somewhat detailed picture of the activity of the Japanese in the oilfields of the Royal Dutch Shell Group in the N.E.I. there follows an overall picture of Japanese activity by comparing their production with the prewar figures.

Annual crude oil production in known areas in N.E.I. (in U. S. bbl.)

	Prewar (1941)	Average annual production during Japanese occupation	Per cent of 1941
Tarakan.....	4,730,000	1,493,000	32
Pladjoe.....	16,631,000	10,044,000	60
P. Brandan....	5,853,000	2,613,000	45
Java.....	4,503,000	3,266,000	72
Total known areas.....	31,717,000	17,416,000	55
Balikpapan....	6,819,000	unknown	
Ceram.....	697,000	unknown	
Grand total....	39,233,000		

All of which tends to show that the Japanese had made large-scale preparations for repairs and as may be concluded from their proportionately important production from the Pladjoe and Java fields, which consist of a comparatively great number of flowing wells, they concentrated their efforts in the first place on flowing wells.

Under present conditions it is impossible to predict when the rehabilitation of the Sumatra and Java oilfields will begin. Plans have already been worked out to resume drilling in these regions with 15 strings. Moreover, crude oil distilling apparatus, as well as plants to improve the quality of products, has been ordered and are ready to be moved into the area as soon as conditions permit.

In the Borneo area an eight-string drilling program is visualized, and in New Guinea the exploration campaign will be resumed with at least four strings. Fortunately no political difficulties are encountered in these areas.

The amount of materials and equipment required for the East Indian Archipelago will largely depend on the state in which the refineries and settlements on Sumatra will be found. According to the preliminary estimates, a total of approximately 200,000 tons of equipment, machinery, and materials will have to be procured. To a large extent these materials have been indented and even ordered, but currency exchange difficulties have an appreciable influence on the choice of manufacturers and thus on the speed of delivery. A further contribution to the difficulty of material supply is the uncertainty of whether cement and other materials, especially those for building and oil engineering work, which previously were purchased locally, will be available again in sufficient quantities.

● **Special equipment.** *Pumping units.* It is estimated that 600 units will be required for the preliminary construction program. On order are 30 power generating units with an aggregate performance of 40,000 kw. Approximately 200 miles of pipe will be needed for drilling and well-finishing purposes. Concerning pipe lines and gathering systems, it is most uncertain as to what size quantities will ultimately be necessary for rehabilitation, as reliable information for several areas is still lacking. Before the Japanese invasion, roughly speaking, 3000 miles of pipe lines of 4-in. and larger diameter were in operation in fields, refineries, and inter-connections, sub-divided as follows:

4 in. 875 miles
5 in. 400 miles
6 in. 650 miles
8 in. 650 miles
8 in. 60 miles
2635 miles excluding Tarakan
3000 miles including Tarakan

It is certain that the percentage of storage capacity to be replaced will be far in excess of the percentage of pipeline length to be reconstructed. Before the invasion approximately 20,000,000 bbl. of storage capacity was available.

Despite the hampering effect of the shortage of some essential materials and of currency difficulties, the Royal Dutch Shell Group is now actively engaged in organizing the gigantic task of rehabilitating, in a few years, the destruction caused by a wanton enemy to fields and refineries that took many decades to build. ★★★

Influence of temperature on oil yield from uncemented sands under gravitational flow*

By **S. L. ZAKS**

Paper translated from Russian reports the effect of temperature on crude oil drainage.

IN contradistinction to other mined minerals, only a small percentage of the crude oil initially in the majority of oil fields is recovered. In fact, there are some deposits from which no crude oil at all can be recovered by any of the usual methods of production. Among such deposits are those in Alberta (Canada) and near Kerch (Crimea) Taman, and elsewhere in Russia.

EXCLUSIVE

The forces that retard the movement of oil through sands toward wells are capillary forces that hold the crude oil in the small pore spaces in the sands, adhesion forces that hold the oil on the surface of the sand grains in the form of thin but continuous films, the viscosity of the oil that regulates the rate of movement of the oil through the pore channels in the sands, and the thickness of the film of oil† on the sand grains.

The influence of these factors on the movement of crude oil in reservoir sands is dependent upon the reservoir temperature. Therefore, the reservoir temperature in turn is a factor on which depends the total quantity of oil recovered and the rate at which it is recovered.

It is well known that the surface tension, the viscosity of the crude oil, and its adhesion tension diminish with increase of temperature regardless of the composition of the oil or the minerals composing the reservoir sand. Consequently, increasing the reservoir temperature by any means will increase the total recovery of oil and accelerate its rate of flow toward wells, pits, or other drainage outlets. Reducing the viscosity of a crude oil,‡ is the greatest manifestation of the effect of heating oil sands.

Observations made on the relationship between the viscosity of a crude oil and temperature show that at a temperature of the order of 90-100°C., the difference between the viscosities of different crude oils is small whereas at a temperature of 20°C. the difference may be considerable. The largest reduction in viscosity is observed when the temperature of crude oils is raised within the temperature range of 0 to 40-50°C. Paraffin-base crude oils change less in viscosity for a given temperature rise than asphalt-base crudes.

This report describes the method and discusses the results of an experimental investigation carried out by the writer in the Laboratory of Petroleum Deposits of the Institute of Mined Fuels of the Academy of Science of the USSR for the purpose of determining the influence of temperature change on the drainage of crude oil from reservoir sands and on the quantity of oil left in the sands when oil is drained therefrom only by the influence of gravity. Such a condition exists in reservoir sands in which the propulsive force is neither gas nor water under pressure. The problems associated with gravitational flow of oil through sands are of particular interest in the recovery of oil by mining.

The experimental apparatus used in the investigations is shown in Fig. 1. For each experiment equal quantities of Lyuberetsk quartz sand were packed into glass tube 1 which is 2.1 cm. in diameter and 70 cm. long. As far as possible every precaution was taken to have the porosities of the sand identical in each experiment. The porosities of the sand-packed columns were 41-42 per cent.

The sand was saturated with Maikop light crude oil (specific gravity = 0.832) through funnel 3 to such an extent that there was no oil in the tube above the sand when the experiment was ready to be begun by allowing oil to drain from the sand into measuring cylinder 4.

The sand-packed tube with the oil-saturated sand column was placed inside cylindrical, electrically-heated furnace 2, the temperature in which was checked by means of the mercury thermometer 5. The temperature within the furnace was maintained constant by means of a temperature regulator (not shown in Fig. 1).

The experiments were carried out with two grades of sand, one having sand grains 0.25-0.10 mm. in size and the other composed of sand grains 0.10-0.01 mm. in size, at temperatures ranging from 20 to 100°C. with the slope of the sand-packed tube varying from 5 to 40 deg. The tube was inclined at different angles to study the effect of the pressure due to the head of oil in the sand-packed tube on the recovery of oil. As the oil in the tube was not replenished, the head of oil decreased as the oil drained from the sand. As a first approximation it may be stated that the average oil pressure in the tube as determined by the Meisner formula equalled:

$$P_{AVERAGE} = \frac{P_1 - P_2}{\ln \frac{P_1}{P_2}}$$

The experiments were carried out in the following manner: The total quantity of crude oil that drained from the sand into the measuring cylinder at the room temperature of 20°C. was determined. After no more oil drained from the sand the temperature in the furnace was increased to 30°C,. which caused an additional amount of oil to drain from the sand. The temperature was maintained until no further oil drained from the sand. The total volume of oil recovered was then measured after which the temperature was increased to 40°C., etc.

The results of the experiments (average data) are given in Tables 1 and 2 and shown graphically in Figs. 2-4. The

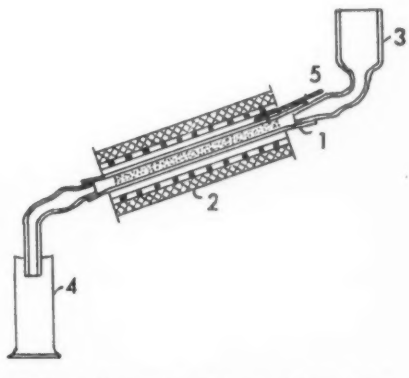

FIG. 1. Apparatus for studying the influence of temperature on the residual oil content of reservoir sands.

*Published in *Izvestiya Akademii Nauk SSSR.* (Otdelenie Tekhnicheskikh Nauk *Bull. Acad. Sci. URSS, cl. Sci. Techn.*) 1944, No. 10-11, 729-33. Translated by A. A. Boehtlingk, Sutter Creek, Amador Company, California.

†The thickness of the oil film depends upon the rate of movement of the oil through the sand and upon the viscosity of the oil and the character of the sand particles [2 3 4].

‡It should be noted that for a repressured oil an increase in temperature will result in diminishing the volume of gas dissolved in the oil, which in turn will lead to a certain increase in the viscosity of the oil. The solution of gas in oil is known to result in a lowering of the viscosity of the oil. The effect of an increase of temperature on the viscosity of a repressured oil, therefore, is offset to some extent by the increase of viscosity due to gas coming out of solution in the oil.

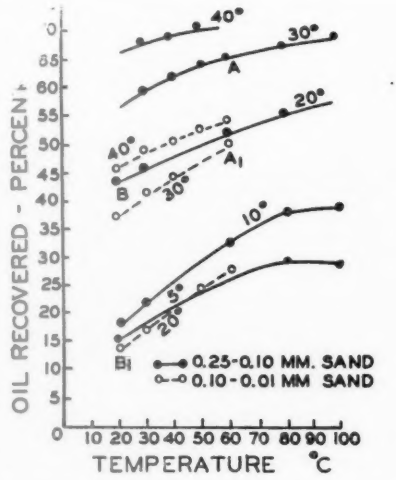

FIG. 2. Changes in the percentage drainage of crude oil from sands of 0.25-0.10 mm. and 0.10-0.01 mm.size as a result of increase of temperature and different slopes of the sand-packed tube.

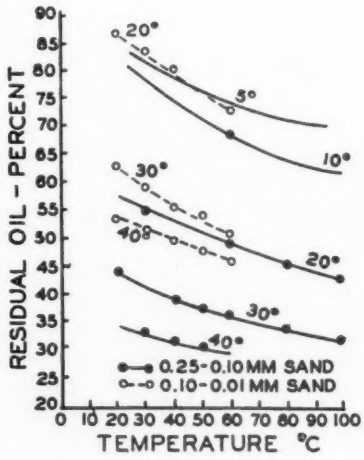

FIG. 3. Residual oil in uncemented sands at different temperatures and different slopes of the tube.

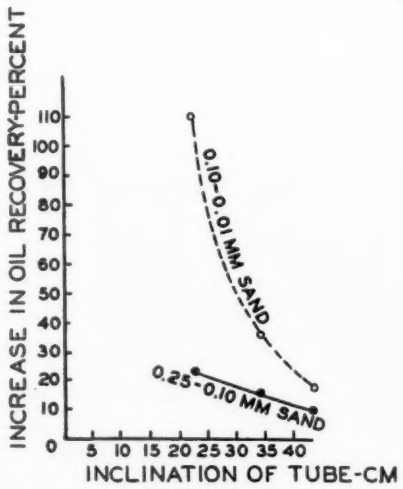

FIG. 4. Increase in the percentage oil recovery due to increase of temperature from 20° C. to 60° C.

experiments were repeated so as to reduce as much as possible the effect of non-uniform packing of the sand grains in the tube.

Without exception, all experiments showed that the volume of oil recovered increased with increase of temperature and that the rate of drainage of the oil decreased as the temperature increased. In the majority of experiments the maximum increase in oil recovered from the sands was observed for increases of temperature within the range of 20 to 60°C. (Table 1 and Fig. 2).

The influence of the size of sand grains on oil recovery is clearly shown in the results of the drainage tests made at room temperature as well as in those made at elevated temperatures. At a given temperature, more oil drained from sands composed of large size grains than from sands of smaller grains. The difference in the volumes of oil that drained from sands of different size sand grains varied from 15 per cent (points A and A_1 in Fig. 2) to 30 per cent (points B and B_1) of the initial oil content.

Fig. 3 shows the percentage change of residual oil in the sand as a function of temperature. The curves that characterize the drainage of oil from the 0.25-0.10 mm. sands have a lesser slope than the curves for the 0.10-0.01 mm. sands. This indicates that the drainage of oil from coarse sands is less complete when the temperature is increased than it is from finer grained sands.

The rate of change of oil recovery from 0.10-0.01 mm. sands under the influence of temperature is greater than that for sands composed of 0.25-0.10 mm. size sand grains. (Table 2 and Fig. 4). This is to be expected for the following reason: The quantity of crude oil retained by sands by capillary forces increases as the size of the pore channels decreases. Moreover, because of the greater total surface of sand faces, the finer sand holds the most film oil. Therefore, the temperature factor has a more pronounced influence with respect to drainage of oil from sands in the case of sands composed of sand grains of small size than it has in coarser sands.

Experiments performed to determine the efficiency of drainage of oil from sands composed of sand grains of different sizes within the temperature range of 20-60°C. and with the sand column inclined at different angles showed that for a given size sand and a given temperature an increase in the angle of slope of the sand tube leads to an increase in the volume of oil drained from the sand. On the other hand, the rate of increase in volume of oil recovered when temperatures are increased diminishes as the angle slope of the sand tube increases. This effect is most pronounced for the finer sands (Table 2 and Fig. 4).

It thus becomes clear that when the angle of slope of the sand tube is increased the role of temperature on the drainage of oil from sands becomes less pronounced. In the cited experiments, when the temperature was increased from 20 to 60°C. and the inclination of the sand packed tube was increased from 20 to 40 deg., the resulting reduction in the rate of increase of oil recovery from the 0.25-0.10 mm. sand was from 21 to 9 per cent and from 109 to 17 per cent in the case of the 0.10-0.01 mm. sand (Table 2 and Fig. 4). This is as it should be for when increasing the slope of the sand packed tube a greater

TABLE 1

Size of sand grains, mm.	Position of sand-packed tube		Percentage recovery of original oil at indicated temperature, °C.							Percentage of original oil remaining in the tube at indicated temperature, °C.						
	Slope, degrees	Difference in elevation of ends of sand column, cm.	20	30	40	50	60	80	100	20	30	40	50	60	80	100
0.25–0.10	5	6.0	15.0	18.0			26.0	29.5	30.5	85.0	82.0			74.0	70.5	69.5
0.25–0.10	10	11.7	18.0	21.0			32.0	38.0	39.0	82.0	79.0			68.0	62.0	61.0
0.25–0.10	20	23.3	43.0	46.0			52.0	55.5	58.0	57.0	54.0			48.0	44.5	42.0
0.25–0.10	30	34.0	57.0	60.0	62.0	64.0	65.0	67.0	69.0	43.0	40.0	38.0	36.0	35.0	33.0	31.0
0.25–0.10	40	43.7	66.5	68.5	69.5	70.5	72.0			33.5	31.5	30.5	29.5	28.0		
0.10–0.01	20	23.3	13.5	17.0	19.5	23.5	27.5			86.5	83.0	80.5	76.5	72.5		
0.10–0.01	30	34.0	37.0	41.5	44.5	46.0	50.0			63.0	58.5	55.5	54.0	50.0		
0.10–0.01	40	43.7	46.5	49.0	50.5	52.5	54.5			53.5	51.0	49.5	47.5	45.5		

TABLE 2

Position of sand-packed tube		Size of sand grains, 0.25-0.10 mm.			Size of sand grains, 0.10-0.01 mm.		
Slope, degrees	Difference in elevation of ends of sand column, cm.	Oil recovered at 20° C., cc.	Oil recovered at 60° C., cc.	Increase in oil recovery, per cent	Oil recovered at 20° C., cc.	Oil recovered at 60° C., cc.	Increase in oil recovery, per cent
20	23.3	43.0	52.0	21	13.5	27.5	109
30	34.0	56.5	65.0	15	37.0	50.0	35
40	43.7	66.5	72.0	9	46.5	54.5	17

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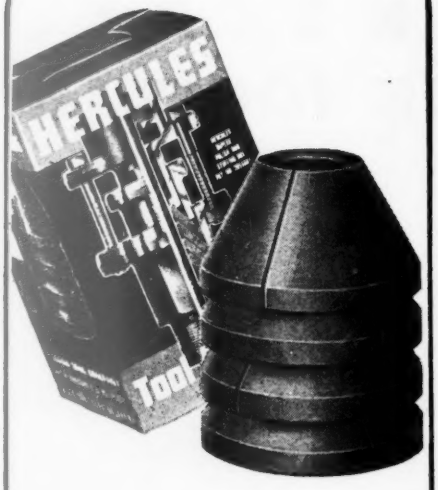

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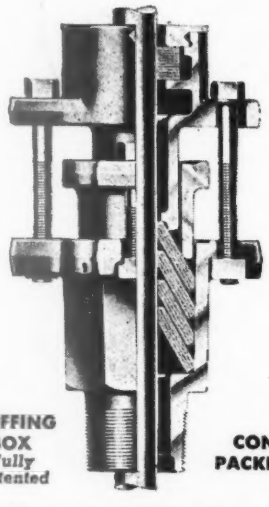

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amount of crude oil drains from the sand without the aid of an increase in temperature and thus the effect of temperature will be less pronounced.

The general conclusion that may be derived from the investigation is that the effect of temperature on the gravity drainage of oil from sands is more marked as the natural forces available to move oil through the reservoir sands decline in magnitude. It also is more marked in finer sands. At the same time, the results of the experiments permit concluding that the maximum effect of a temperature increase on increase of oil recovery from sands may be reached when, for a given temperature increase, the viscosity of the crude oil decreases most rapidly. It is observed also that the greater change in viscosity due to temperature change occurs in the region of highest viscosity.[5]

The above conclusions are confirmed by the experiment carried out by A. B. Sheinman who, when investigating the role of temperature on the primary and secondary displacement of crude oil by gas pressure, demonstrated that the most marked effects of temperature were noted when the sands were saturated with the most viscous crude oil.[6]

The experiments suggest that heat should be applied primarily to such deposits as are composed of fine-grained sands, at low temperatures and containing high viscosity crude oil. A deposit of that type, for example, is the Ukhta. The temperature in the formation of that field is about 6° C. at which temperature the oil is very viscous yet it is characterized by the property that its viscosity is greatly reduced by a small increase of temperature (seven fold when raising the temperature from 6 to 30°C.) It is necessary, however, to raise artificially the temperature of the oil sand only 20 to 30°C. to cause a marked increase in the rate of drainage of oil from the sand. A still greater effect on the rate of drainage of oil from sands would materialize by heating artificially the oil deposits in the Arctic region. There also will it be of great practical interest in connection with the above study to investigate the drainage of oil from sands in the presence of water.

This investigation was conducted through the initiative of M. A. Kapelyushnikov, member of the Academy of Science of USSR, with the assistance of O. N. Zhelenina.

Bibliography

1. S. L. Zaks, Thermal Methods for the Intensification of the Production of Crude Oil, Dissertation 1943.
2. B. Deryagin, Doklady Akademii Nauk SSSR (Compt. Rend. Acad. Sci. URSS) *39*, 11, 1943.
3. L. Landau and R. Levich, *Acta Physico-Chimica URSS*, *17*, 42, 1942.
4. M. M. Kusakov and K. S. Krym, *Izvestiya Akademii Nauk SSSR*, Otedlenie Tekhnicheskikh Nauk *(Bull. Acad. Sci. URSS, Cl. Sci. Tech.)* 1944, No. 4-5.
5. M. M. Kusakov, Trudy Soveshchaniya po Vyazkosti Zhidkostei i Kolloidov (Reports on Conference on the viscosity of liquids and colloids) In Russian. Published by the Academy of Science of USSR, *1*, 149, 1941.
6. A. B. Sheinman et al., *Izvestiya Akademii Nauk SSSR*, Otdelenie Tekh. Nauk *(Bull. Acad. Sci. URSS, Cl. Sci. Tech.)* No. 7-8, 1941.

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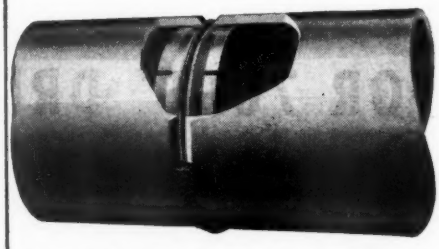

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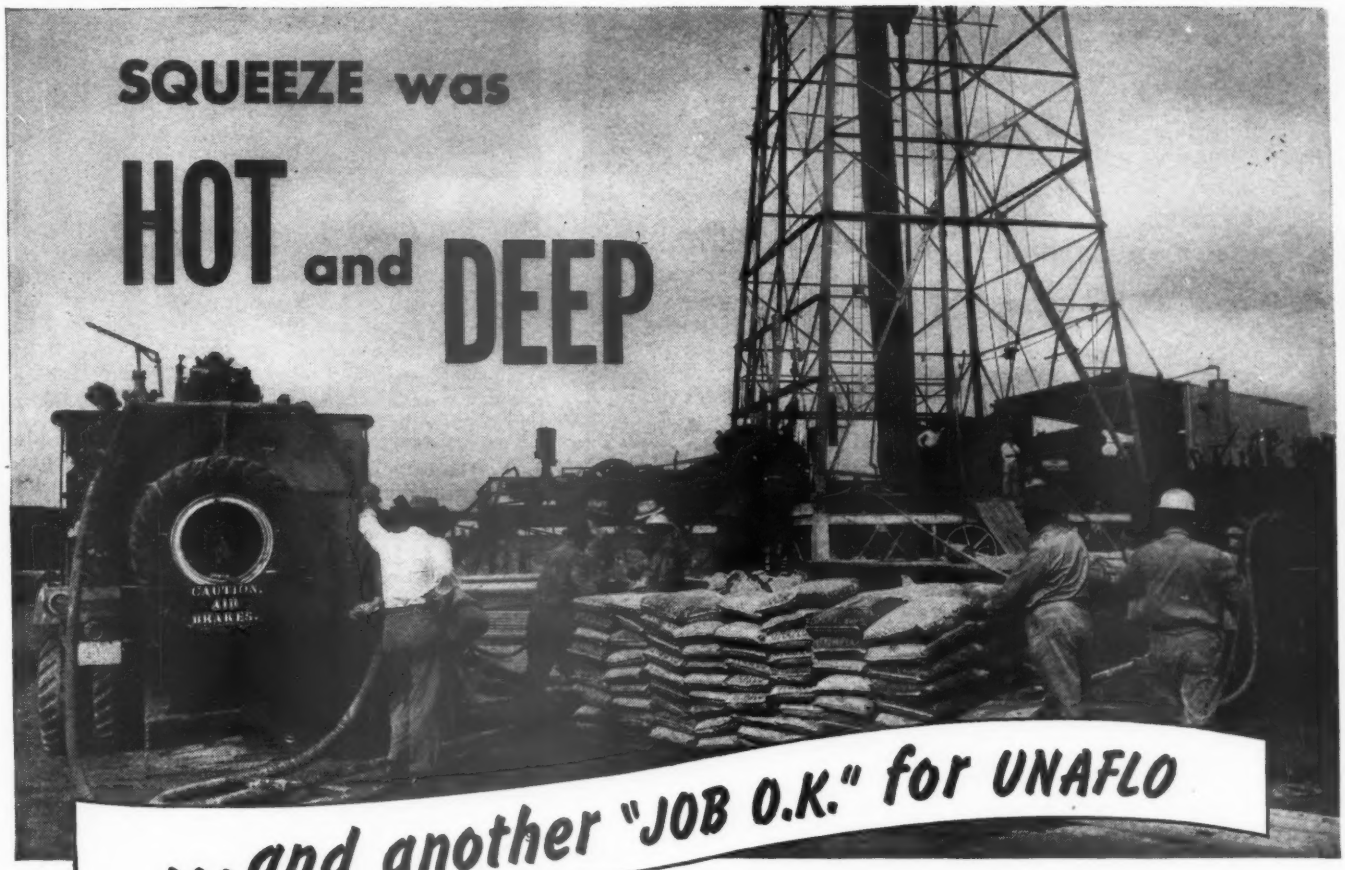

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Humble dedicates products terminal

EXCLUSIVE Petroleum Engineer Picture Story

By W. J. DAVIS

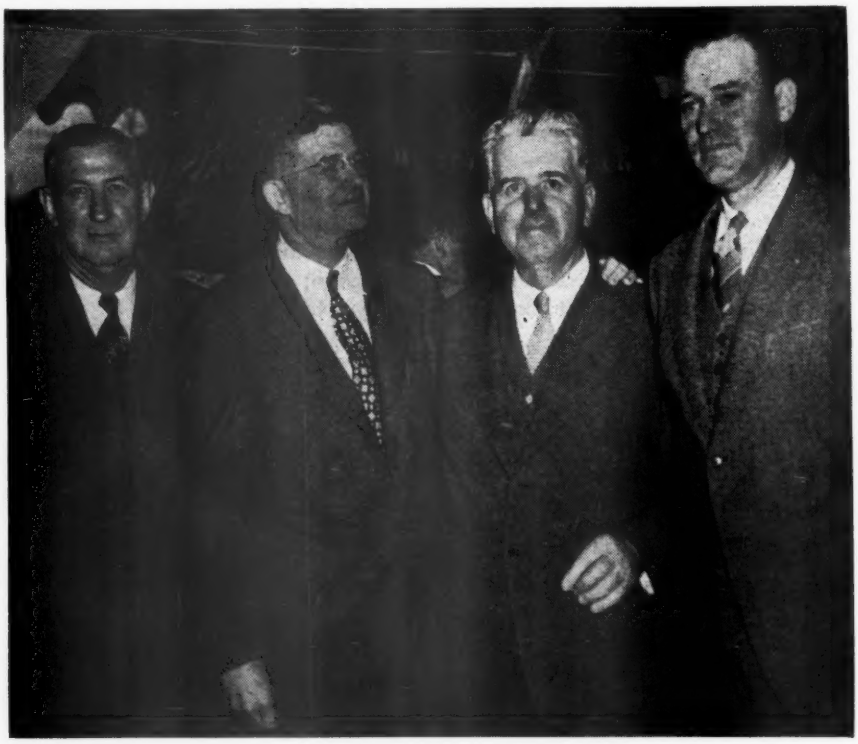
A DRIZZLING rain failed to dampen the celebrating spirit of 300 Humble Oil and Refining Company employees and their guests at the dedication of Irving products terminal October 15. The station is the present terminus of Humble's $4,000,000 finished products line from Baytown to Irving, Texas. The 8-in. line also has loading facilities at Houston, Hearne, and Waco.

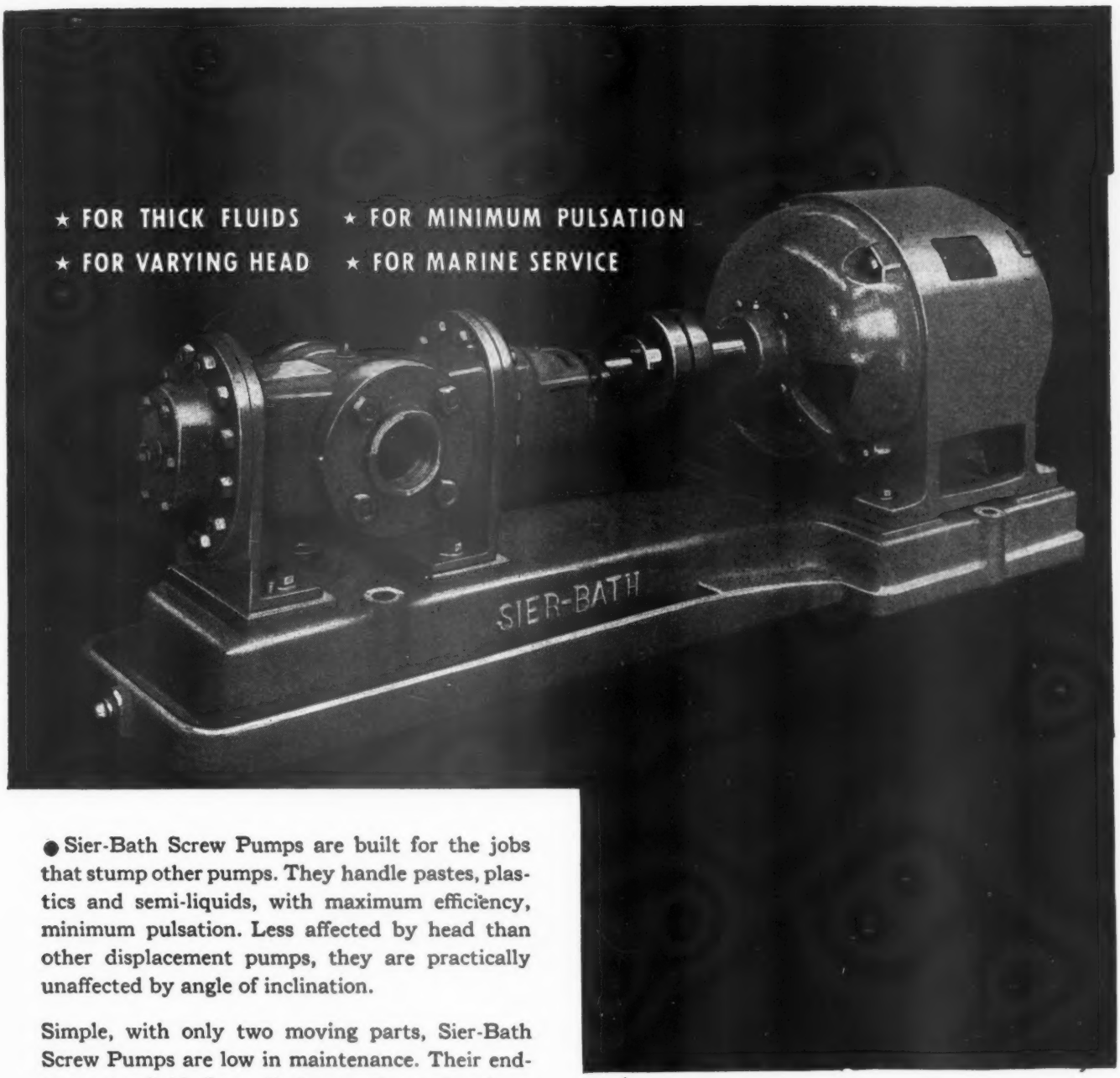
Master of ceremonies was G. A. Mabry of the Humble company and E. J. Johnson, mayor of Irving, welcomed the group. R. V. Hanrahan, president of Humble Pipe Line, reviewed the work that had been done in spite of the war and shortages and outlined further expansion of his department in North and West Texas. J. A. Neath, member of the board of directors, Frank Watts, sales manager, and Hines H. Baker, executive vice-president, rounded out the list of speakers.

The loud speaker system was turned over to a gaily-colored cowboy band fresh from the Texas State Fair at Dallas while pipeliners, refiners, and town folk pitched in on the hot coffee and barbecue with appropriate trimmings.

The new terminal is to provide both truck and tank car loading facilities for all grades of gasoline marketed by the company. Automatic shut-offs are pro-

Attending the dedication were, left to right, J. A. Neath, on the board of directors; Hines H. Baker, executive vice-president; R. V. Hanrahan, and Mayor Johnson.





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vided at both racks and permit the setting, in advance of loading, of a given amount of fluid to be loaded. The electrical pumping equipment shuts down when the predetermined amount has been loaded. All pumping is remotely controlled from either rack. Average loading rate from any of the outlets is 450 gal. per min. by means of two 6-in. new type pipe line pumps. Storage facilities include one 30,000-bbl. tank at present and will be increased to a total of 115,000 bbl. by the first of the year.

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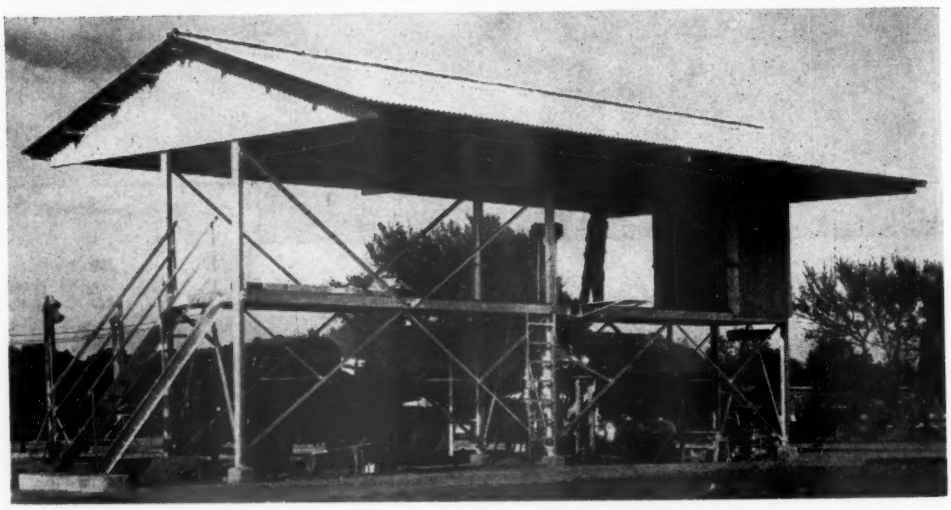
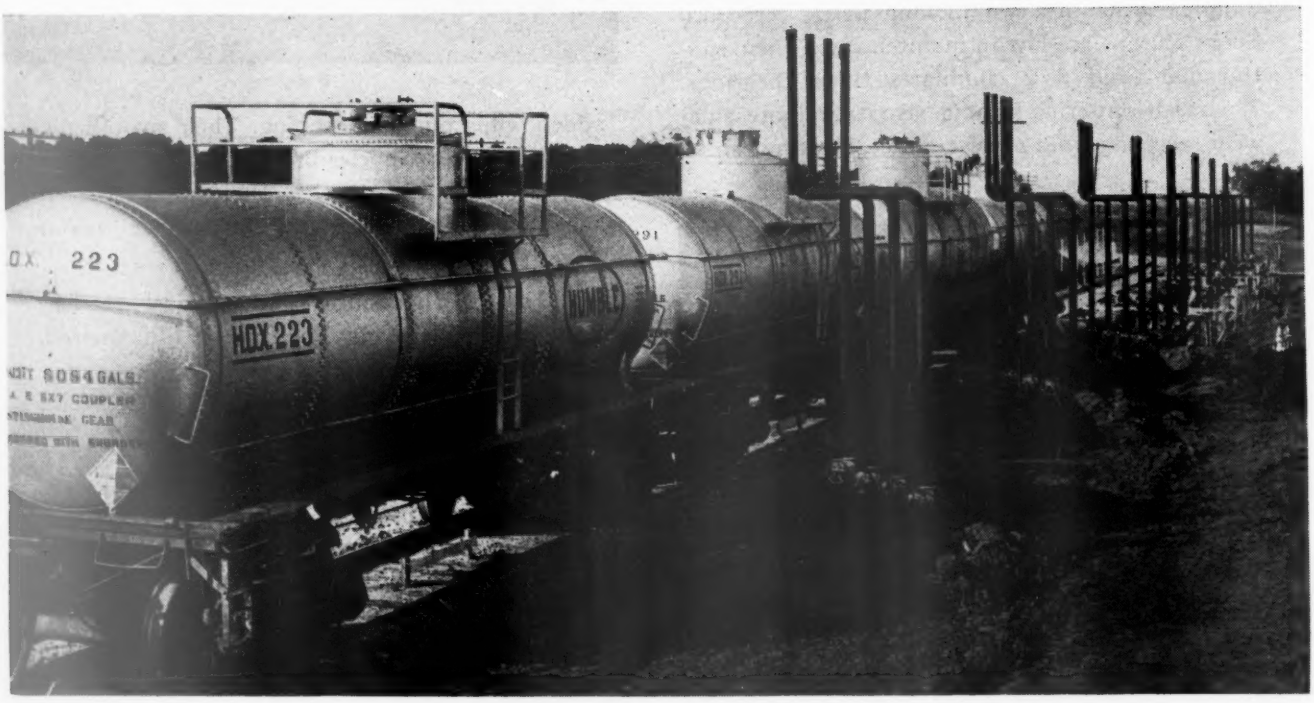
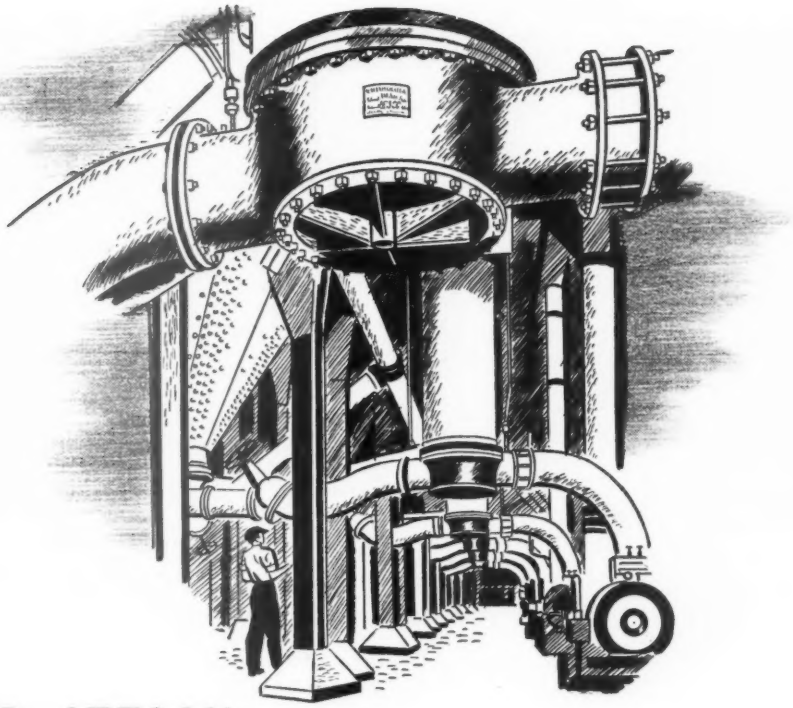


The truck loading rack with spacious concrete drives operates at present only from one side until delivery of a second pumping and metering unit to complete the installation.

The eight-car spot when completed will allow finished products to be loaded out from 6-in. headers supplying from one to four grades of fuel.

THE END





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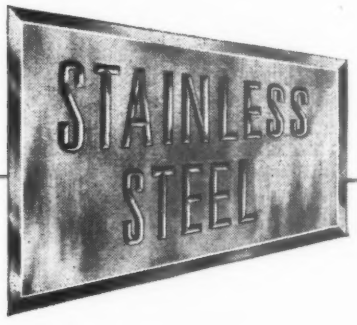


BEAUTIFUL ENDURING STRONG TOUGH

Graphic method of selecting roller chain drives for multiple speed transmissions

By **WALTER BROWN,** *Assistant Chief Mechanical Engineer,*
International Derrick and Equipment Company

As the average depth of oil wells increases year by year, the demand for faster and more flexible drilling rigs increases.

EXCLUSIVE A clear tendency to widen the speed range of both the drum and the rotary drives can be noted. This leads to an increase in the number of speeds and to more elaborate but more flexible transmissions. Recent investigations have shown that certain favorable speed patterns can produce a considerable reduction of "coming out of the hole" time compared with certain other speed patterns having the same number of speeds and the same engine power.

The majority of newer designs of medium size and heavy rotary drilling rigs have six forward speeds with three chains between two shafts, and two chains between the second and a third shaft. Others obtain eight to nine speeds in a similar way. In most of the designs the shaft centers are fixed, and no means is provided for adjusting the chain center distance for wear.

In laying out a chain transmission for a drilling rig the designer is confronted with the task of finding two or three chain drives that satisfy the following conditions:

1. **The chains should not be overstressed when running with full power at lowest speed.**
2. **The chain pitch should be selected so that the chain can withstand the highest speed that it might have to run.**
3. **The sprocket ratio should fit as closely as possible into the desired speed pattern.**
4. **The chain centers should not be so short as to crowd the chain and not so long as to make the drive and transmission housing too heavy and expensive.**
5. **The centerdistance, pitch, chain length, and sprocket should be selected so that the difference between the theoretical centerdistance of the slackest and the tightest chain should be less than one-tenth of the pitch length.**
6. **The pitch sizes used should be as much alike as possible from the production and cost standpoint.**
7. **Sprockets with the same pitch and the same number of teeth should be used when possible for the same reason.**

A design that takes all these points into consideration will have to be a compromise. An economical solution can be obtained only by figuring through a large number of cases and eliminating the less desirable ones. This process, if carried through with some degree of thoroughness, is very time consuming, especially because of the clumsiness of the exact centerdistance formula for chain drives, which is shown below.

Graphs prepared by some roller chain manufacturers are made only to give the approximate centerdistance needed for single chain drives with adjustable centerdistances, and they are difficult to read closely enough for the above purpose. Other manufacturers of roller chains publish tables showing the exact centerdistance of drives between some small sprockets in combination with a large number of large sprockets and chain lengths. These tables, while helpful as far as they go, cover much too small a part of the total range that should be considered.

The figures from these tables, however, can be used to good advantage as starting points for the graphic method described below. The exact formula for the centerdistance of chain drives reads:

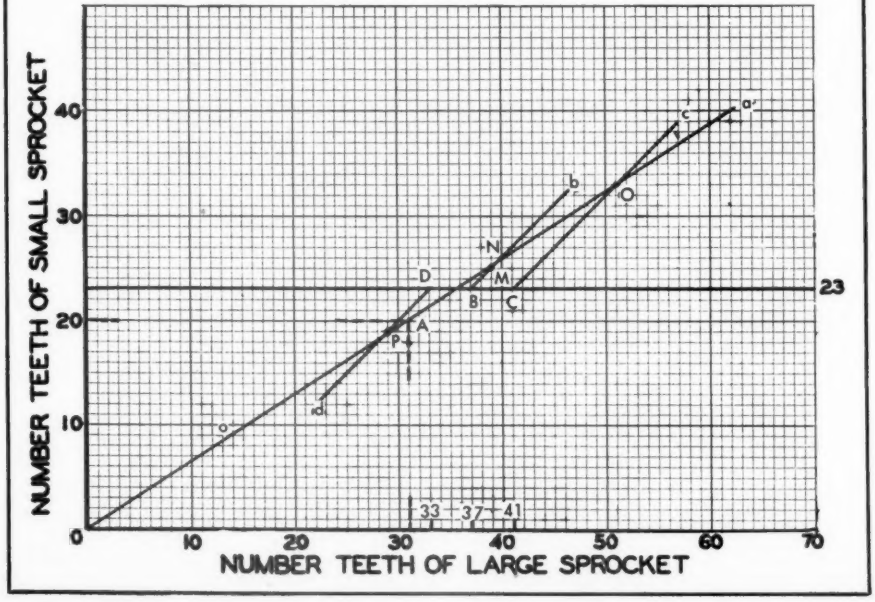
$$C = \frac{L - \frac{N}{2} - \frac{n}{2} + \sqrt{\left(L - \frac{N}{2} - \frac{n}{2}\right)^2 - 8\left(\frac{N-n}{2\pi}\right)^2}}{4}$$

C = centerdistance in pitches
L = chain length in pitches
N = number of teeth of large sprocket
n = number of teeth of small sprocket.

If a value "a" is added to L, N, and n, the terms $\left(L - \frac{N}{2} - \frac{n}{2}\right)$ and $(N - n)$ remain unchanged because "a" cancels out. C, therefore, is independent of the size and prefix of the value "a". In other words, the centerdistance remains unchanged if a whole number is added to or subtracted from the values L, N, and n.

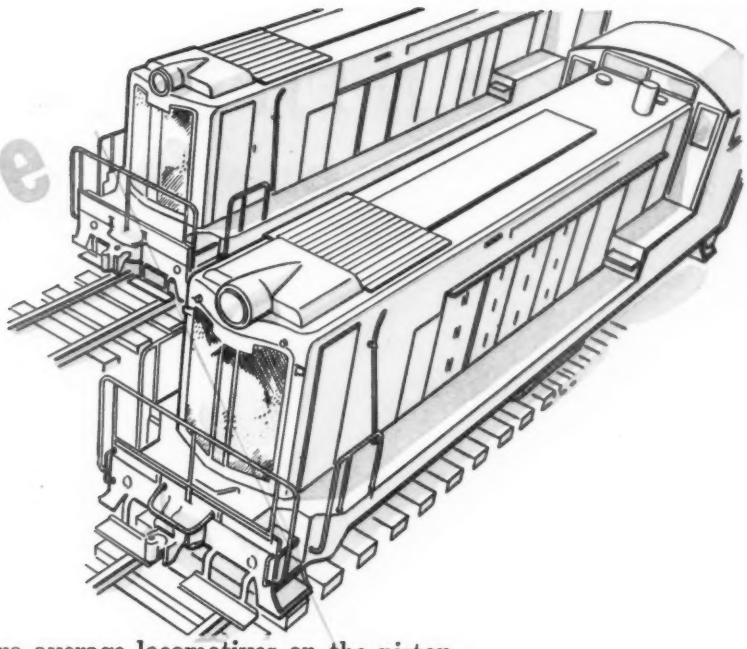
In a system of rectangular coordinates with "N" as abscissa and "n" as ordinate, a straight line at an inclination of 45° to the coordinates represents all chain drives having the same centerdistance. We have to keep in mind at the same time that the value C and the term $\left(L - \frac{N}{2} - \frac{n}{2}\right)$ are unchanged only when L is increased or decreased the same amount in pitches as N and n in number of teeth.

FIG. 1. Diagram showing number of teeth of the large sprockets marked on the abscissa and the number of teeth of the small sprockets marked on the ordinate.



Pressure

LIKE 2 LOCOMOTIVES ON THE PISTON HEAD



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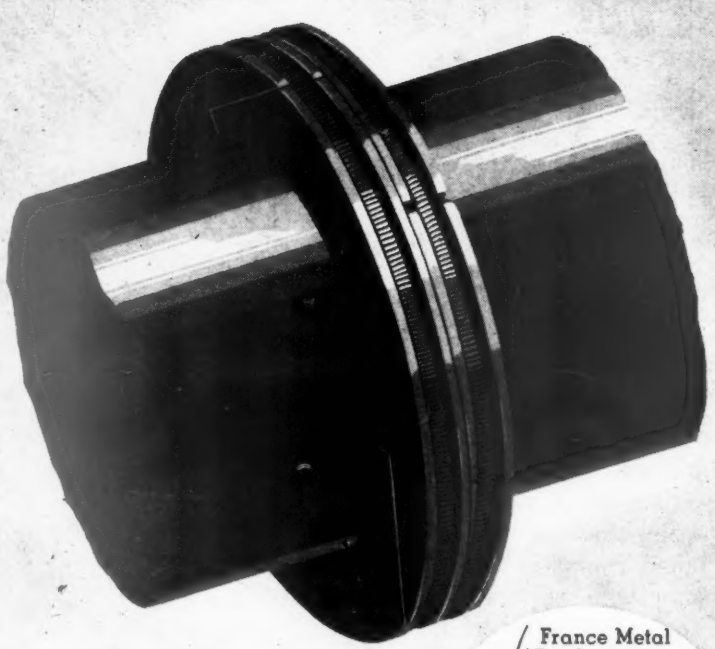

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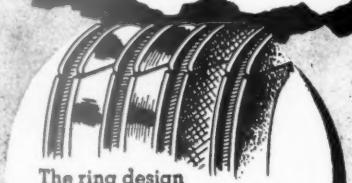

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This graphic method of selecting chain drives is explained in the following example:

We have a chain drive consisting of a 23 and a 62-tooth sprocket and a chain 88 pitches long. The centerdistance is 21.865 pitches. We want to design a second drive with the same shaft centers having a sprocket ratio of about 20:31.

The diagram (Fig. 1) shows the number of teeth of the large sprockets marked on the abscissa and the number of teeth of the small sprockets marked on the ordinate. A line, "o-a", drawn from the zero point through point A ($x = 31$, $y = 20$) represents all points corresponding to the desired sprocket ratio 20:31. A horizontal line "23" ($y = 23$) represents all drives having a small sprocket of 23 teeth.

In the above mentioned centerdistance table, covering the combination of a 23-tooth sprocket with a complete line of large sprockets, one or more drives are selected with centerdistances differing from the centerdistance of the first drive (21.865) less than one tenth of a pitch. The corresponding points are marked on the horizontal line "E-F" for the 23-tooth small sprocket. The points C, B, and D, for instance, have the following characteristics:

Point	Number of teeth of large sprocket	Chain length in pitches	Centerdistance in pitches, "C"	Difference between "C" and 21.865
C	41	76	21.812	— .053
B	37	74	21.8865	+ .0215
D	33	72	21.943	+ .078

The intersections between line "o-a" and lines "B-b", "C-c", and "D-d" (drawn at an angle of 45° from the points B, C and D) give the desired solution. Line "B-b", for example, intersects with line "o-a" near point M corresponding to a sprocket ratio of 25 to 39. The corresponding chain length would be 76 pitches (74 plus 25 minus 23). Another possible solution would be point N corresponding to sprocket ratio of 26:40 and a chain length of 77 pitches. An odd number of pitches in the chain requires an offset link.

Line "D-d" originating from point D located to the left of the intersection between line "o-a" and the 23-tooth line gives point P, corresponding to a drive of 19 and 29 teeth and a chain length of 68 links ($72 - 23 + 19$).

In a similar way line "C-c" produces at point "O" a solution with 33 and 51 teeth and 86 pitches of chain.

Which one of these solutions should be used or whether still other solutions should be investigated will depend on considerations such as shaft diameters safety factor, limiting speeds or space requirement.

The described method eliminates the work of having to solve a complicated formula containing two second powers and one square root. It will give the designer more time to investigate the speed pattern of his rig, enable him to select a more favorable one, and solve his problems more rapidly than heretofore.

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The pH of waters from gas-condensate wells saturated with carbon dioxide at various pressures*

By **H. ARTHUR CARLSON**
Phillips Petroleum Company

● **Summary.** The pH of waters from several gas-condensate wells, saturated with carbon dioxide, has been measured at various pressures to determine whether the pH is low enough to give accelerated corrosion. Four water samples (three gas-condensate well waters and one oil well water) saturated with carbon dioxide at pressures from 20 lb. per sq. in. to 80 lb. per sq. in. at room temperature (77°F.) ranged in pH value from 4.7 at the lowest pressure to 4.1 at the highest pressure. A fifth sample differed from the others in that it exerted a strong buffer action to carbon dioxide under pressure at a pH of 5.2. Spectroscopic analysis indicated borate to be present, which may account for the buffering action of that water.

The system $CaCO_3$ (solid) + $CaSO_4$ (solid) + CO_2 + H_2O has a strong buffering action at a pH of 5.25 at pressure up to 80 lb. per sq. in. This system may be present in some wells. These natural buffers present in water produced from high pressure gas-condensate wells influence the degree of acidity produced in these waters by solution of carbon dioxide and is another variable affecting the corrosiveness of these waters.

The pH is related to the partial pressure of the carbon dioxide present, and not to the total pressure. The partial pressure of carbon dioxide in gas condensate wells does not usually exceed 80 lb. per sq. in. The estimated pH at the wellhead can be calculated from the wellhead pressure and the per cent carbon dioxide in the gas, assuming equilibrium has been reached. For example, well B has a wellhead flowing pressure of 4100 lb. per sq. in. and 1.88 per cent carbon dioxide in the gas. The partial pressure of carbon dioxide is: 4100 × 1.88% = 77 lb. per sq. in. Reading from Table 2, a pH of 4.2 is obtained. The presence of carbon dioxide at the high pressures of the gas condensate wells gives a partial pressure of carbon dioxide sufficient to produce a pH low enough to cause accelerated corrosion.

Preliminary laboratory colorimetric measurements of pH using a double window Jerguson gage indicate that the hydrogen-ion concentration can be determined in the field at wellhead pressures by employing this type of instrument made of stainless steel.

*Presented before the NGAA Corrosion Research Project Committee, October 17, 1946, Dallas, Texas.

● **Introduction.** One of the most difficult problems in corrosion has recently arisen in the operation of high pressure gas-condensate wells[1]. Corrosion occurs in well equipment where temperature and pressure conditions permit condensation of water. Pressures in these wells are from 1500 lb. per sq. in. to as high as 6500 lb. per sq. in. and temperatures range from 150°F. to 250°F. Most of these wells produce gas and hydrocarbon condensate containing carbon dioxide, but no oxygen and usually no hydrogen sulphide. The presence of carbon dioxide at the high pressure involved, suggests that the condensed water should have a low pH while it is under pressure. It is the purpose of this investigation to determine the pH of waters from some gas-condensate wells saturated with carbon dioxide at various pressures to indicate whether the pH is low enough to give accelerated corrosion. Certainly no intelligent choice of corrosion-resisting materials (such as alloys) or proper treatment with chemicals to decrease the corrosiveness, can be employed without some knowledge of the acidity of the corrosive liquid under pressure.

● **Experimental method.** The colorimetric method using standard buffer solutions was utilized in this investigation of determining pH at pressures above one atmosphere. The pH colorimetric measurements were made in 6½-oz. clear glass crown-capped bottles. A 3/32-in. diameter hole was drilled in the center of each bottle cap. The cork was removed from the caps and self-sealing butyl rubber gaskets (5/16 in. in diameter and 0.1 in. thick) were glued with rubber cement on the inside of the cap over the hole. Oil-resistant rubber gaskets 15/16 in. in diameter were then cemented to the self-sealing gaskets, and the caps were ready for use. These 15/16-in. gaskets were used to replace the cork normally present in the bottle caps. They were specially treated to remove all traces of sulphur and other impurities. The preparation of the special rubber used in making these gaskets was described in a paper by Fryling[3]. The bottle with the water sample was capped and mounted on a ringstand. A 3-in. diameter clear Lucite tube open at both ends was placed around the bottle as a safety measure.

A 2-reduction stage regulator with a maximum delivery pressure of 150 lb. per sq. in. was attached to a supply cylinder of carbon dioxide of approximately 99.5 — 100.0 per cent purity. A Baroid air hose suitable for a working pressure of 100 lb. per sq. in. was attached to the delivery side of the regulator. A 25-gauge stainless steel hypodermic needle was silver soldered to a special adapter and this adapter was then fitted on the other end of the air hose. The hypodermic needle was inserted into the bottle through the hole in the bottle cap.

● **Materials.** The indicators and the buffer solutions employed as standards in the colorimetric measurement of pH were obtained from the Central Scientific Company. Buffer tablets compounded from the formulas of Kolthoff, McIlvaine and others manufactured by the Coleman Electric Company accurate to ± 0.02 pH unit at 30°C. were also used. These buffers differed successively in pH by 0.2 units. By proper mixing of

TABLE 1

pH of carbon dioxide solutions at 25° C. (77°F.) colorimetric measurements.

CO_2 pressure in lb. per sq. in. abs.	pH
20	3.8
40	3.6
60	3.5
80	3.4

TABLE 2. pH of carbon dioxide saturated well waters.

Well	Date sampled	Total solids in p.p.m.	Initial pH of water	pH at indicated CO_2 pressure, lb. per sq. in.			
				20 lb.	40 lb.	60 lb.	80 lb.
A	2-23-45	702	6.45	4.6	4.4	4.3	4.2
B	4-10-46	7,653	5.4	4.6	4.4	4.3	4.2
B	8-18-44	15,858	4.6	4.5	4.4	4.3	4.1
C	5- 1-46	37,498	8.0	5.5	5.2	5.2	5.2
D	3-14-46	141,623	6.3	4.7	4.6	4.5	4.4

(a) Atmospheric pressure (no carbon dioxide added)

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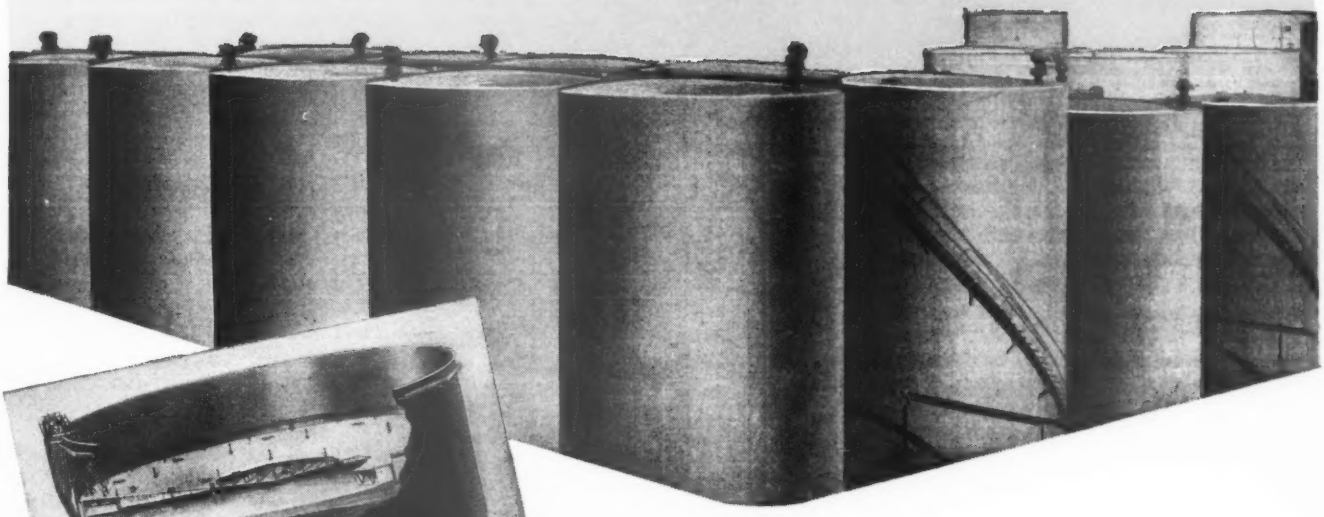

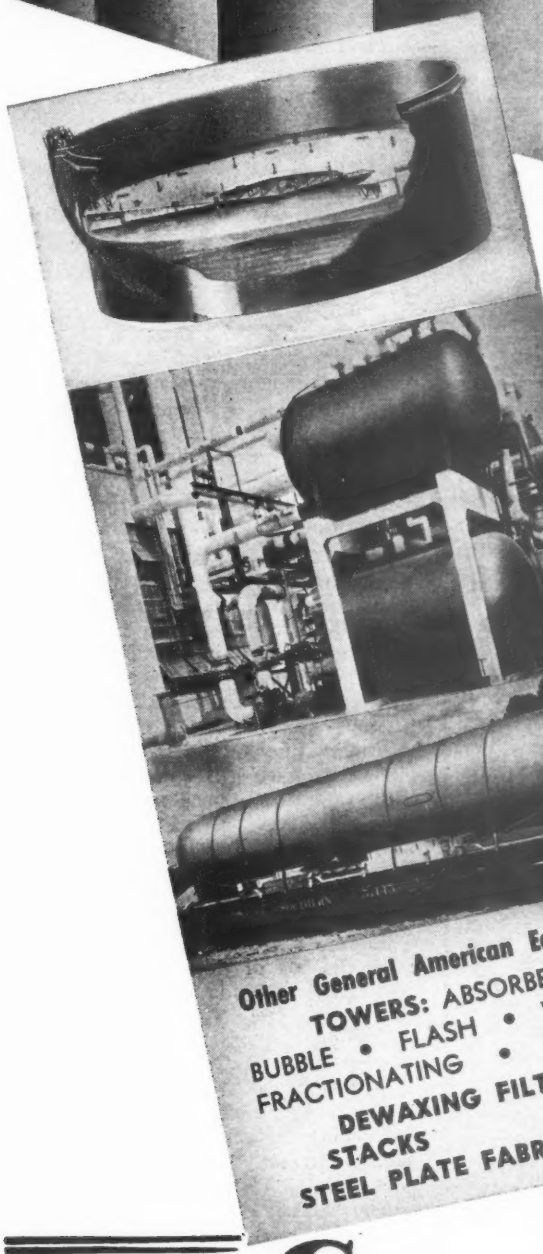

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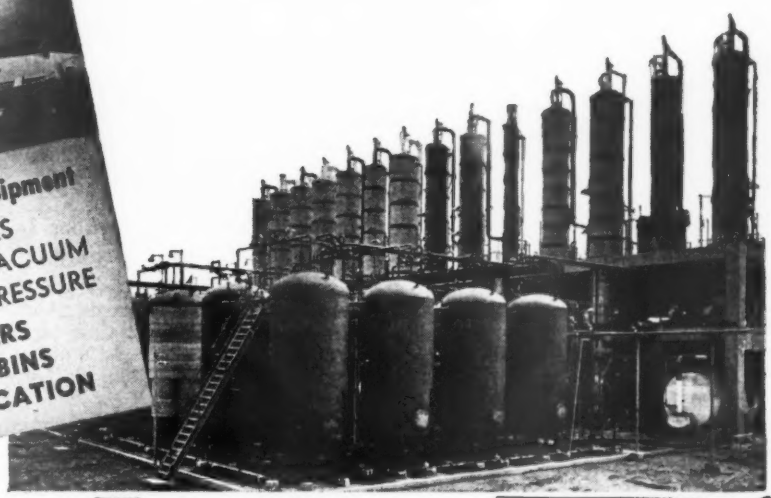

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TABLE 3. Production data.

Well	A	B	B	C	D
Date sampled	2-21-45	4-10-46	8-18-44	3-25-45	3-14-46
Formation	Sand	Lime	Lime	Sand	Brown Dolomite
Reservoir temperature, °F.	230	218	218	210	Estimated 85
Reservoir pressure, lb. per sq. in.	5200 calc.	4900 calc.	6300 calc.	3895 at 8950 ft.	..
Wellhead flowing temperature, °F., est.	170	140	140	170	85
Wellhead flowing pressure, lb. per sq. in.	3300	4100	4554	2700	..
Production rate, million cu. ft. per day	6.68	1.45	....	2.1	..
Distillate production, bbl. per day	211	138	....	80	1
Water production, bbl. per day	10	2	....	4	225
CO_2 in gas, mole per cent	0.96	1.88	1.88	0.99	
Calculated partial pressure, CO_2, lb. per sq. in.	32	77	85	27	..
Estimated pH at equilibrium	4.5	4.2	4.1	5.4	..

TABLE 4. Water analyses.

Well radical (p.p.m.)	A	B	B	C	D
Total solids	702	7,653	15,858	37,498	141,623
Sodium and potassium	195	1,877	4,111	13,843	50,867
Silica	....	....	....	....	....
Iron	52	141	Present	None	....
Calcium	19	924	1,705	441	2,543
Magnesium	8	74	158	101	1,056
Chlorides	187	4,688	9,692	21,459	83,060
Bicarbonates	239	74	90	1,636	247
Sulphates	4	16	102	24	3,850
Hydrogen sulphide	Absent	Absent	Absent	Absent	Absent
Organic acids	159	Present	Present	Present	..
Gravity at 60° F./60° F.	0.9960	1.0067	1.0142	1.0244	1.1057
pH	6.45	5.4	4.6	8.0	6.3
Date sampled	2-23-45	4-10-46	8-18-44	5-1-46	3-14-46

buffers, solutions differing in pH by 0.1 unit were obtained. These buffer solutions were checked before being used with a Leeds and Northrup pH meter.

The water used was obtained from the regular laboratory distilled water supply and was boiled to free it from dissolved air. Carbon dioxide was bubbled into the test solutions to displace air before the bottle was capped.

The colorimetric standards were made up using 192 ml. of buffer and 8 ml. of 0.04 per cent solution of the desired indicator and placed in the bottles. Bromphenol blue indicator was used in the pH range of 3.0 to 4.6, bromcresol green from 4.0 to 5.4 and chlorophenol red from 5.2 to 6.8.

The same volume, 192 ml., of the test water and 8 ml. of 0.04 per cent solution of the indicator were placed in the bottle. A series of readings were taken on the same sample by increasing the pressure. The sample was shaken until equilibrium was reached before its color was compared with the standards. By matching colors, the pH value was ascertained with a precision of 0.1 pH unit. Fluorescent lighting was used with a white paper as a background.

● **The pH of carbon dioxide saturated waters.** By the colorimetric method described above, the hydrogen-ion concentration of conductivity water saturated with carbon dioxide was determined in this laboratory at 20, 40, 60, and 80 lb. per sq. in. abs. The values are presented in Table 1. These values agree closely with the values reported by Moore and Buchanan[4]. They report the pH of carbon dioxide solutions for 18 pressures between 15 and 490 lb. per sq. in. (1 and 33.3 atmospheres) is 3.7 to 3.3. They found that the hydrogen-ion concentration reached a minimum of a pH of 3.3 at 80 lb. per sq. in. and did not decrease with further increase of pressure[4]. Muller and Luber[5] determined colorimetrically the pH of a carbon dioxide solution to be 2.9 at 734 lb. per sq. in. (50 atmospheres).

It was found in this laboratory that the system $CaCO_3$ (solid) + $CaSO_4$ (solid) + CO_2 + H_2O has a strong buffer action at a pH of 5.25 at pressures of 20, 40, 60, and 80 lb. per sq. in. abs. Shipley and McHaffie[6] have shown that this system has a strong buffering action at a pH of 5.11 (determined by electrometric titration) at pressures up to one atmosphere.

In the study of distillate well corrosion, all reported pH measurements of well waters have been made at atmospheric pressures. This has given rise to misconceptions. Actually, the pH will be lower at well pressures than at atmospheric pressure, for carbon dioxide is absorbed by the water under pressure. Therefore it seemed desirable to determine the pH of well waters saturated with carbon dioxide at pressures above one atmosphere.

The gas-condensate well water samples are from the Gulf Coast region and from East Texas. An oil well water sample from the Panhandle area with a total solid concentration of 141,623 p.p.m. was selected to study the effect of high concentration of brine on the pH.

The pH of five well waters with salt concentration ranging from 702 p.p.m. to 141,623 p.p.m., saturated with carbon dioxide at pressures of 20, 40, 60, and 80 lb. per sq. in. are shown in Table 2. The pH is related to the partial pressure of the carbon dioxide present and not to the total pressure. The calculated partial pressure of carbon dioxide and an estimated pH at the wellhead assuming equilibrium is presented in Table 3, together with production information on

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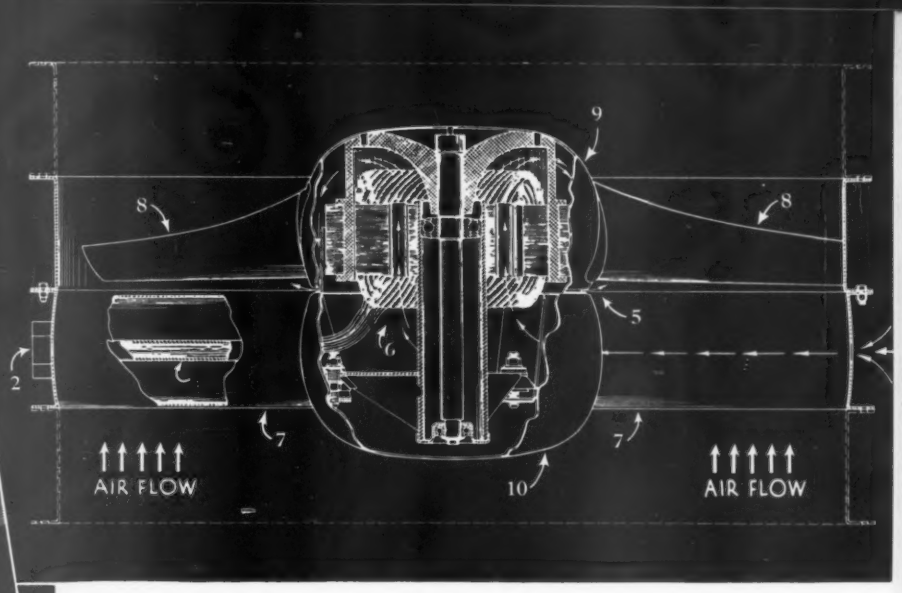

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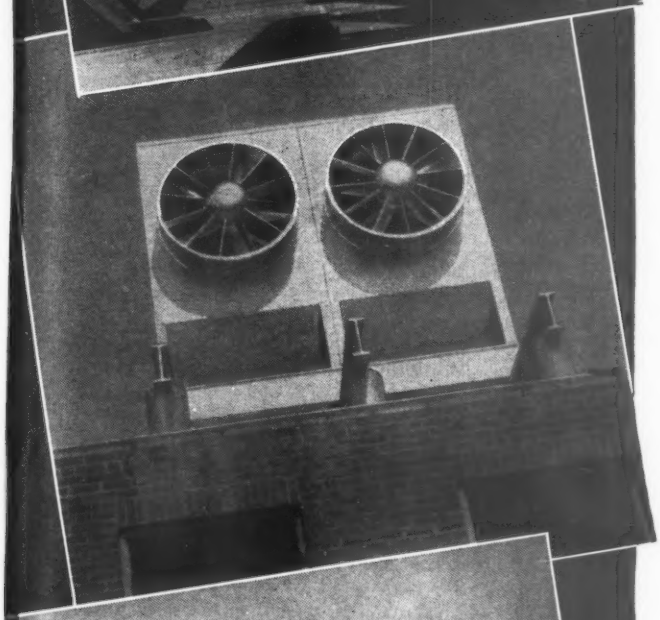

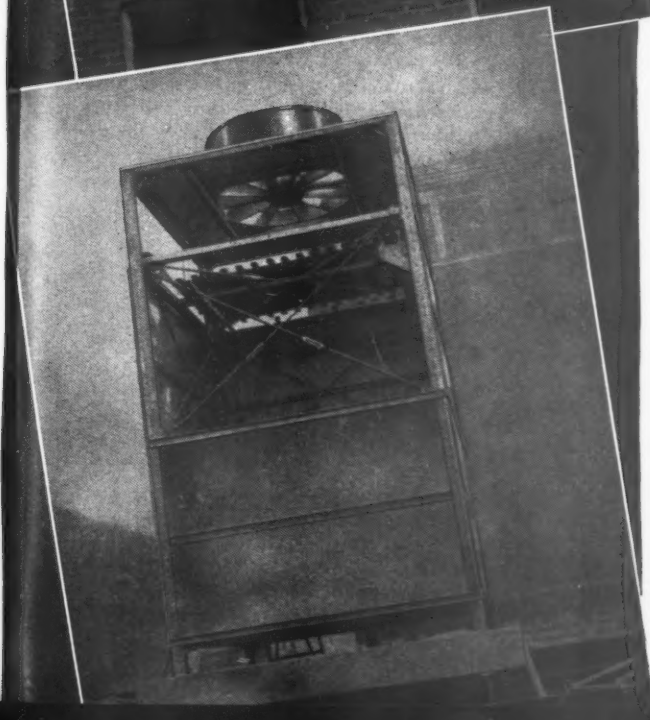

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the 5 wells. The chemical analyses are given in Table 4. The total solids may vary considerably with the rate of production, depending upon the amount of condensation of water. The two water samples from Well B taken at different dates is an example of this variation in total solids. Oftentimes the variation is much greater than in this particular case.

A weak acid will cause hydrogen gas evolution to begin at a higher pH than is required with a strong acid[6]. Carbonic acid causes hydrogen gas evolution at a pH of about 5.4, whereas hydrochloric acid requires a pH of 4.1[6]. Carbonic acid is only 6 per cent dissociated at a pH of 5.4, while hydrochloric acid is 100 per cent dissociated. As a result, the total available acidity of the carbonic acid at pH 5.4 is 16 times as great as the actual hydrogen-ion concentration, and consequently its capacity to neutralize the alkaline film against the metal should be as great as that of a hydrochloric acid solution with 16 times the hydrogen-ion concentration; that is, a hydrochloric acid solution of pH of 4.2[6]. It can be seen from Table 2 that the well waters at all pressures of carbon dioxide have a pH of 5.5 or less, indicating that these waters are corrosive when carbon dioxide is present. The low pH of well waters indicates that the acid-type corrosion is a dominating factor in gas-condensate well corrosion. Four of the water samples reached a limiting pH value of 4.1 to 4.4 at 80 lb. per sq. in. pressure, while one water sample exerted a strong buffer action to carbon dioxide at all pressures at a pH of 5.2. Spectroscopic analysis of this water indicated borate to be present, which may account for the buffering action. Aeration tests on this well water increased the pH indicating the removal of dissolved carbon dioxide and excess bicarbonates. Natural buffers present in water produced from gas-condensate wells influence the degree of acidity of the well water, and affect the corrosiveness of these waters.

Battelle[2] has found that the corrosion of steel in a $N_2 + CO_2 + H_2O$ system to be related to the partial pressure of carbon dioxide present, and not to the total pressure.

The pH of the system $CaSO_4 + MgO + CO_2 + H_2O$ was determined colorimetrically to be 4.9 at 20 lb. per sq. in. and 4.4 at 40 lb. per sq. in. pressure.

It was established experimentally that the pH of sodium chloride solutions saturated with carbon dioxide varies directly with increasing concentrations of the salt. This is to be expected since increasing the concentration of the solution will decrease the solubility of carbon dioxide. The results are presented in Table 5.

TABLE 5

The pH of sodium chloride solutions saturated with CO_2.

Concentration parts per million	20 lb. per sq. in.	40 lb. per sq. in.	60 lb. per sq. in.	80 lb. per sq. in.
100,000	4.3	4.1	3.9	3.7
10,000	4.2	3.9	3.8	3.7
1,000	4.1	3.8	3.7	3.6
100	3.9	3.7	3.6	3.4
0	3.8	3.6	3.5	3.4

Preliminary experiments were made using a Jerguson gage in order to develop a field test method for determining pH colorimetrically under pressure at the wellhead. A Tygon coated double window Jerguson gage gave erratic colorimetric pH readings, probably because the Tygon coating failed to protect the metal. The gage was cleaned and given seven coats of Amercoat No. 44. Laboratory experiments again gave erratic pH readings. A stainless steel double window Jerguson gage should work satisfactorily for colorimetric pH measurements under pressure, such as is encountered in the field.

Literature Cited

1. Bacon, T. S., and Brown, E. A., *Oil & Gas Jour.* **42**, No. 49, 91-2 (1943).
2. Battelle Memorial Institute. Unpublished data. Second Progress Report on the Corrosion of High Pressure Natural Gas Equipment to the N. G. A. A., Jan. 10, 1945.
3. Fryling, C. F., Paper presented at the 110th Meeting of the American Chemical Society, Chicago, Illinois, Sept. 9 to 13, 1946.
4. Moore, M. B., and Buchanan, J. H., Iowa State College *J. Sci.* **4**, No. 4, 431-9 (1930).
5. Muller, E., and Luber, A., *Z. anorg. allgem. Chem.* **187**, 209-30 (1930).
6. Shipley, J. W., and McHaffie, I. R., *J. Soc. Chem. Ind.* **42**, 317 (1923).
7. Whitman, W. G., Russell, R. P., and Altieri, V. J., *Ind. Eng. Chem.* **16**, 665-70 (1924).

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Total	$265,949,507.14

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Surplus	10,000,000.00	$ 20,000,000.00
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Letters of Credit		3,344,749.27
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Individual	$144,464,155.27	
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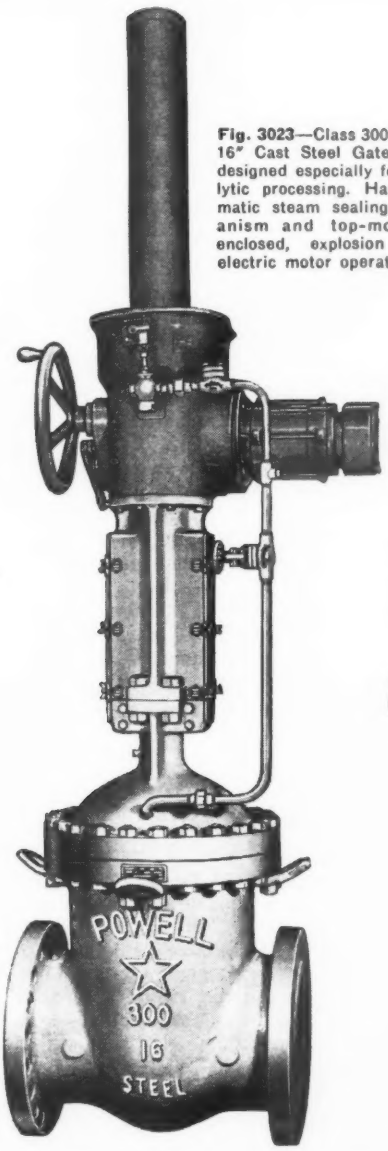

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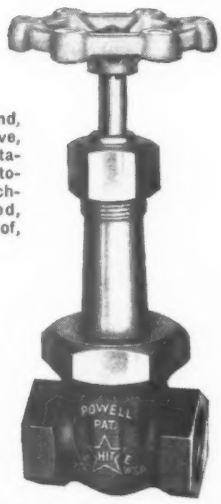

Fig. 375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet, and renewable, wear-resisting "Powellium" nickel-bronze disc.

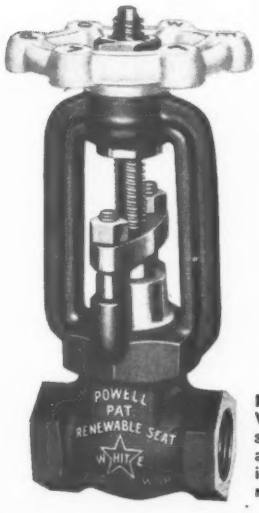

Fig. 386—200-pound Bronze Gate Valve with screwed ends, outside screw rising stem, screwed-on yoke and bonnet, renewable wear-resisting "Powellium" nickel-bronze seat rings and taper wedge solid disc.

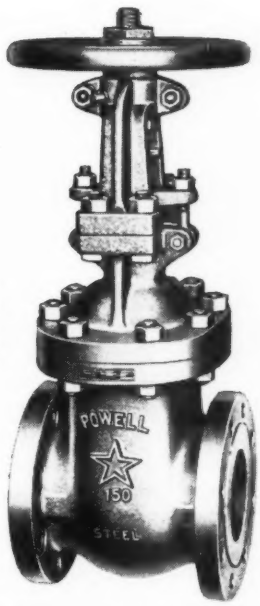

Fig. 1503—Class 150-pound Cast Steel Gate Valve with bolted flanged yoke, outside screw rising stem and taper wedge solid disc. Powell Cast Steel Valves of all types are available in pressure classes from 150 to 2500 pounds, inclusive.

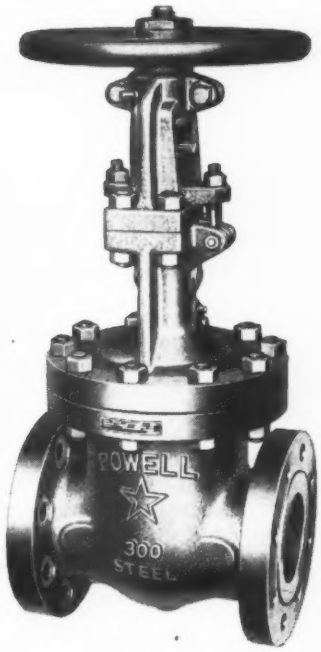

Fig. 3003—Class 300-pound Cast Steel Gate Valve with bolted flanged yoke, outside screw rising stem and taper wedge solid disc.

POWELL VALVES

Simplified pipe line computations

By **PEYTON BRYAN,** *Assistant Division Engineer,* Humble Pipe Line Company

PART 1

THIS and subsequent articles are designed for the engineer whose proficiency in pipe-line hydraulics has been limited to, and by, the use of flow tables or charts, and the manipulation of formulas he may not understand fully. Despite the possible loss of interest by any real hydraulician who may have read this far, we will first find the derivation of those formulas with which most writers on the subject begin their expositions.

EXCLUSIVE

Helpful as flow tables and curves are, they are not always available in the field; nor do they contain all the answers to every problem of pipe-line flow. They are all based upon equations that may be put into this form:

$$H = f\frac{L\,V^2}{2\,g\,D}$$

Wherein:

H is the height, in ft., of the column of liquid required to impart a velocity of V ft. per sec. to 1 lb. of the liquid, through a pipe of length L ft. and diameter D ft. The units chosen for L and D may be any you like, but they must be the same for each term, which is a disadvantage, for pipe diameters are usually expresed in inches whereas pipe-line lengths are expressed in feet or miles.

As our primary concern is not velocity through the pipe but rate of flow, it will be convenient to express V in terms of the usual oil industry unit for rate of flow, the barrel (5.614 cu. ft.) per hour, which will be represented hereafter by B. Bear in mind that B does not mean barrels, but barrels per hour; it is not a quantity, but a rate of change of quantity.

Now, for our convenience, we want to effect two changes in the fundamental equation. We want to express D in inches and L in feet, and we want to express V in terms of B. Also, taking the value of g, the acceleration of gravity, at 32.16, we shall incorporate it into the other constants of our revised equation. Then:

$$H = f\frac{(12)\,(L)}{(64.32)\,(d)\,(12.233\,d^4)}\,B^2$$

$$= f\frac{0.01525\,L\,B^2}{d^5}$$

It will also be convenient to have H represent a definite gradient, or rate of fall in "head," just as B represents a definite rate of flow. Considering L equal to 1000 ft. in the above equation:

$$h = f\frac{15.25\,B^2}{d^5} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and h is the hydraulic gradient, or loss of head per 1000 ft., occasioned by the flow of B through a pipe of diameter d inches. More properly, B is the flow occasioned by the hydraulic gradient h.

As most pressure gauges are calibrated to read in pounds per square inch, we should have an equation to fit them. Referring to the first form of equation (1), the pressure, in pounds per square inch, exerted by a column of liquid of height H is:

$$P = \frac{62.5\,s\,H}{144} = 0.434\,s\,H$$

$$H = \frac{P}{0.434\,s}$$

with s meaning specific gravity. As with equation (1), the pressure equation is more covenient in the form of a definite gradient; in this case, the pressure drop in pounds per square inch, per mile. Considering L equal to 5280 ft., and expressing H in terms of P:

$$p = f\frac{(0.434\,s)\,(0.01525)\,(5280)\,B^2}{d^5}$$

$$= f\frac{34.95\,B^2\,s}{d} \quad . \quad . \quad . \quad . \quad . \quad (2\text{-a})$$

The customary oil industry expression for gravity being in deg. API, which unit is converted to specific gravity by the equation

$$s = \frac{141.5}{(API + 131.5)}$$

we can substitute this value in equation (2-a), and get

$$p = f\frac{4945\,B^2}{(API + 131.5)\,d^5} \quad . \quad . \quad (2\text{-b})$$

Everything would be simple, now, were it not for that f. Every hydraulician deserving the name has published equations or curves relating the values of f, or a similar coefficient, to values of other factors in the problem; velocity of flow, density and viscosity of the liquid, diameter and interior roughness of the pipe. C. E. Main wrote a series of articles for *The Petroleum Engineer* in 1935, expressing the conviction that they were all wrong; especially those who put their faith in what has been variously known as the Stokes Criterion, or the Reynolds Number. Acceptance of that criterion as a means of evaluating f has increased, however, and it is now generally agreed that f, the friction factor, is a function of a dimensionless quantity called the Reynolds Number written: $R = \frac{D\,V}{z}$ with R as the Reynolds Number, D as pipe diameter in feet, V as velocity of flow in ft. per sec., and z as kinematic viscosity, which is usually expressed in a unit of the metric system called the stoke. In order to reconcile the English units of the numerator to this metric unit, a conversion modulus of 929.03 (the metric equivalent, in cm. x cm. per sec., of D V) is introduced. As before, we want to express pipe diameter in inches, and velocity in terms of B, so the final Reynolds equation will be:

$$R = 929.03\,\frac{d}{12}\,\frac{B}{z\,3.5a} = 22.14\,\frac{B}{d\,z}$$

Unfortunately, there is no practical means of measuring directly the kinematic viscosity of a liquid, but its value can be obtained from the indications of viscosimeters. The time, in seconds, required for 60 cc. of the sample to flow through the tube of the Saybolt Universal Viscosimeter is the most widely used expression for viscosity among pipe-line engineers. For highly viscous liquids a tube of larger bore is employed and the time of efflux for this tube (about one-tenth of that for the Saybolt Universal) is expressed as Saybolt-Furol Seconds. It would be convenient to have a viscosimeter whose indications bore a simpler relationship to kinematic viscosity than do any now in use, but conversion charts are readily obtained for any standard meter. Chart 1 is an adaptation of part of the Viscosity Conversion Chart (P 216.3) in *Petroleum Engineer's Continuous Tables.*

Although it is agreed that the friction factor, f, is a function of the Reynolds Number, there is a failure to agree on the precise relationship, so that among the published curves of various hydraulicians there are slight variations in the value of f resulting from the same value of the Reynolds Number. Fritz Karge, in his excellent article, "Design of Oil Pipe Lines," in the March, 1945, number of *The Petroleum Engineer,* gave a graph of several curves derived from the work of R. S. J. Piggott, each applicable to a different pipe material (brass tubing, cast iron, concrete, steel, etc.) If your work deals with these diverse materials you will require such a graph, which can be found in any good mechanical engineers' handbook.

Assuming your concern to be with ordinary commercial line pipe, we will stick to one such curve, and because it has always given results that checked well with observed pressures and flow rates, we will use the values given by W. F. Durand in his *Hydraulics of Pipe Lines.* As there is a degree of annoy-

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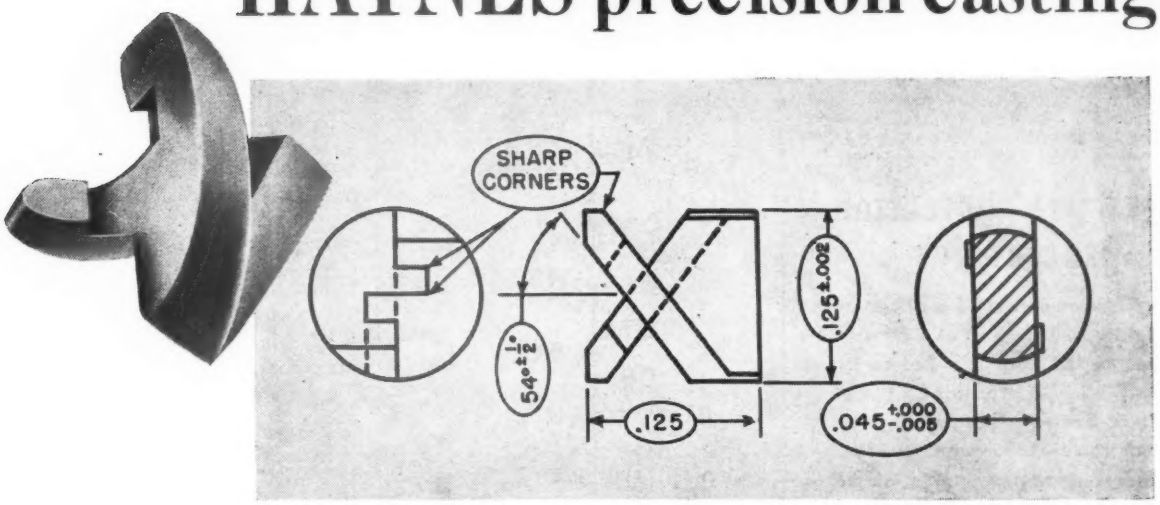

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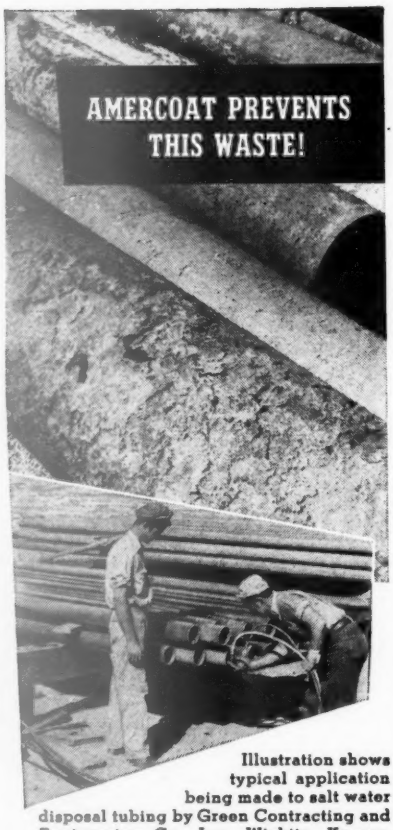

Illustration shows typical application being made to salt water disposal tubing by Green Contracting and Engineering Co., Inc., Wichita, Kansas.

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ance and uncertainty in interpolating for values of f on even larger-scale logarithmic graphs, these values are tabulated directly in Table 1.

It would seem that we now have sufficient apparatus for the solution of flow problems. We do — in one direction. That is, given a required rate of flow, the diameter of the line, the oil's viscosity in SUS, and gravity in deg. API, we can find the "head," in feet of liquid, or the pressure, in pounds per square inch, necessary to induce that flow. For example, it is required to find the pressure necessary to pump 275 bbl. per hr. through 10 miles of 4-in. line, the oil having an API of 42 deg. and viscosity of 35 SUS.

CHART 1.

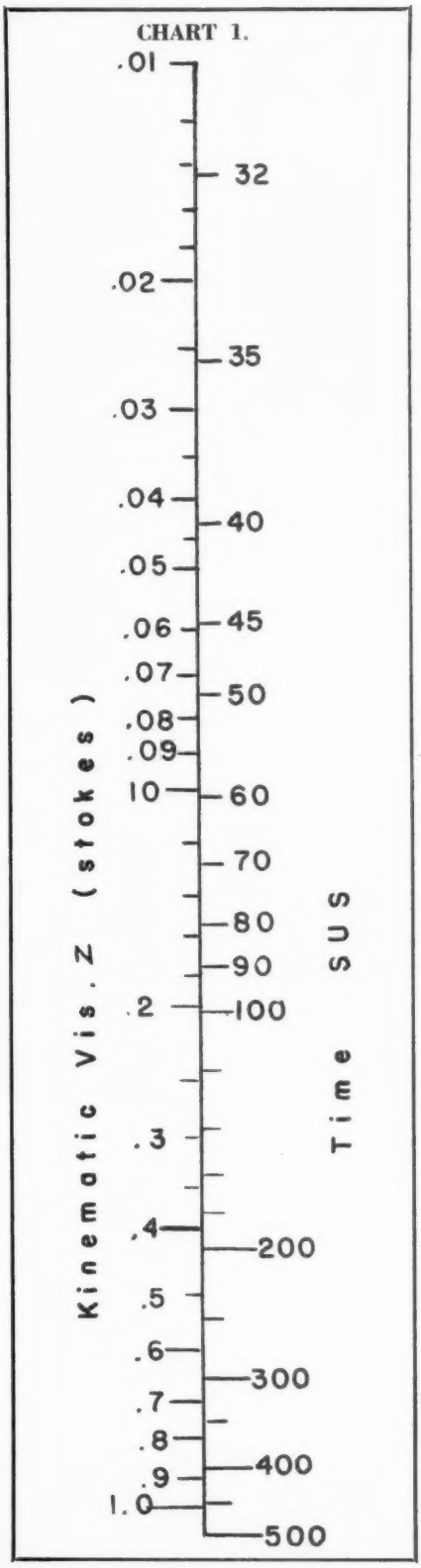


TABLE 1
Friction factors (from W. F. Durand)

Reynolds number (R) in thousands	Friction factor (f)
5	0.0382
6	0.0364
7	0.0350
8	0.0340
9	0.0330
10	0.0320
12	0.0304
14	0.0292
16	0.0280
18	0.0271
20	0.0264
25	0.0249
30	0.0238
35	0.0228
40	0.0219
45	0.0213
50	0.0208
60	0.0200
70	0.0195
80	0.0190
90	0.0185
100	0.0180
150	0.0168
200	0.0158
250	0.0150
300	0.0144
350	0.0140
400	0.0137
450	0.0134

$$R = 22.14 \frac{B}{d\,z}$$

$$h = f \frac{15.25\,B^2}{d^5}$$

$$p = f \frac{34.95\ s\ B^2}{d^5}$$

From the conversion chart, 35 SUS is equivalent to a kinematic viscosity of 0.026 stokes.

$$R = 22.14 \frac{275}{4(0.026)} = 58{,}540$$

$f = 0.0201$

By equation (2-b)

$$p = (0.0201)\,\frac{(4945)\,(275)^2}{(42+131.5)\,(4)^5} =$$

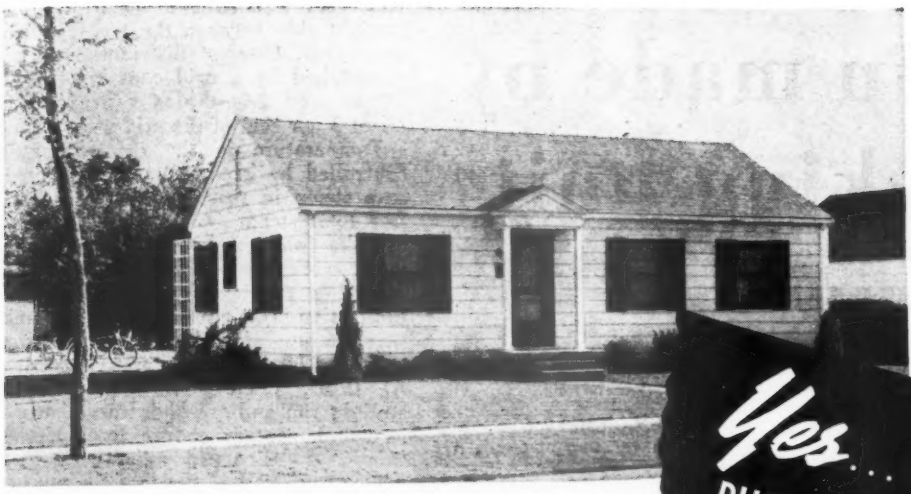
42.3 lb. per sq. in per mile

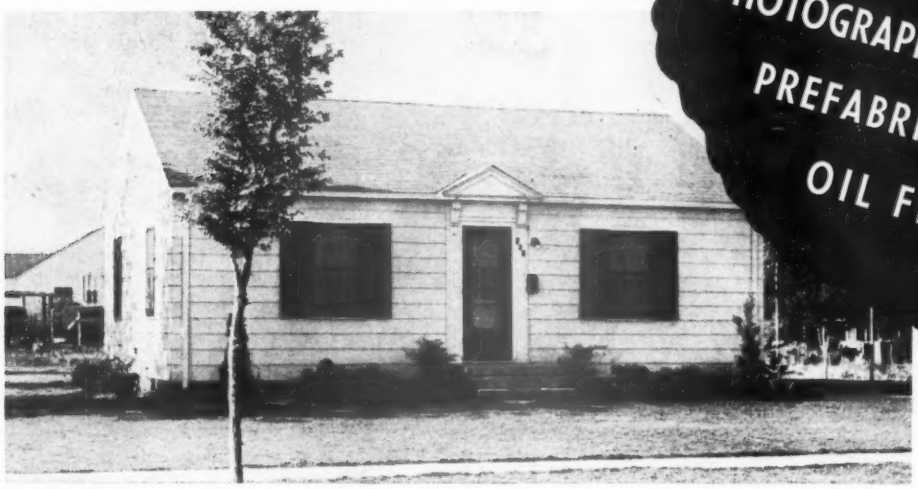
or 423 lb. per sq. in pressure required for the 10 miles.

If the problem is to find what rate of flow will result from a given pressure gradient, however, a direct solution is impossible due to the presence in our equations of f, whose value is partly determined by B, the unknown. The classic method has been to assume a trial value for B, substitute it in the Reynolds equation in order to get a trial value for f, and then solve the resulting flow equation to see whether it comes out even. It wont, so other values of B are tried until an f is found, which makes the two sides of the equation equal. With practice, you may be able to hit upon the right value of B after three or four trials, but it is a cumbersome way to work.

The one-way traffic over these equations is but one reason for the desirability of getting rid of that f term, or rather, of incorporating it into the other constants. Another reason is that as we come to consider more involved problems of flow we will find them all but impossible of solution with that awkward f tagging along. In a future article, we will do away with it.

(Part 2 will be published soon)





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Record run made by Avon cracking unit

By **JAMES SETH**

Tide Water Associated Oil Company

THE scheduled shutdown for inspection and repairs of the Avon fluid catalytic cracking unit at the Avon, California, refinery of the Tide Water Associated Oil Company on September 8, 1946, ended a run of record length for this type of refining facility. The only other previous turnaround was completed over a year ago, and the unit began this record run in July, 1945. The Avon fluid unit operated a total of 415½ days between turnarounds and processed approximately 8,000,000 bbl. of fresh feed, exclusive of recycle.

During the record fluid run, a few minor interruptions to the flow of oil occurred, but no extensive maintenance work was done. Some mechanical trouble was encountered in the main blower governor mechanism early in the run just completed. After an unsuccessful attempt to repair the small governor device controlling the blower speed, it was removed completely and operation continued on hand control. On another occasion, oil feed was discontinued for a few hours to repair a small catalyst leak in a line where oil vapors were present.

The Avon unit was licensed by Universal Oil Products Company. This organization also assisted in the startup of the unit and its initial operation. In test runs made early in 1945 without interrupting its wartime production of aviation gasoline components, the unit easily passed all performance guarantees on both natural and synthetic catalyst as well as guarantees on certain specific features of performance.

General process design was by Universal Oil Products Company in conjunction with Tide Water Associated engineers and those of the contractor, C. F. Braun and Company. As a result, the unit embodies some features of standard U.O.P. units as well as many improvements contributed by C. F. Braun engineers. Through the excellent cooperation of operators of other fluid units, it was possible for the Associated engineers to utilize all the experience available from operating units and those under construction and to incorporate many valuable ideas into the design of the Avon unit.

The unit was constructed by C. F. Braun and Company in the relatively short time of only 10½ months of actual construction work with a smaller than average working force. This was made possible by a maximum amount of shop fabricated material and the use of modern up-to-date construction equipment. The same contractor also constructed simultaneously with the cracker four other units at the Avon Refinery, including the gas plant to handle and separate the gas and gasoline stocks produced by the cracker, and the feed preparation unit where residuum is vacuum flashed to obtain a heavy waxy gas oil for charge to the catalytic cracker.

The unit was completed and first started on December 29, 1944. It was placed in regular operation in January, 1945. The first run, as was the practice on most wartime fluid units, was on natural catalyst. After a few days operation on this material, the natural catalyst was withdrawn and synthetic catalyst was substituted. At this time, no complete shutdown or inspection was made, the changeover requiring less than two days. The synthetic catalyst allowed the maximum production of base stocks for 100-octane gasoline manufacture. Such first run was terminated by a scheduled shutdown for inspection and repairs on June 20, 1945. Repair work included normal maintenance items, as well as the usual minor mechanical changes made as a result of operating experience on a new unit. Inspection of the unit at that time disclosed that it was in excellent shape and indicated that the interval between inspections could be substantially lengthened.

The record run was started up on the aviation base stock type of operation using American Cyanamid synthetic catalyst. With the end of the war, operation was shifted to motor gasoline operation as fast as conditions would permit. As soon as stocks of synthetic catalyst on hand were used up, the catalyst additions were made with Filtrol natural catalyst. As a result, the run began on 100 per cent synthetic catalyst and ended with a mixture estimated to be nearly all Filtrol catalyst. Since the beginning of postwar operations, natural catalyst costs have averaged approximately 2 cents per bbl. of fresh feed charged. Catalyst acivity has been maintained at relatively high levels as indicated by the space velocities employed during the run.

This unit has the largest regenerator of any of the wartime units built. The regenerator is 46 ft. in effective diameter with a height of 30 ft. on the straight side between the top and bottom cones. Catalyst distribution is accomplished by a grid containing 278 1½-in. and 2-in. holes representing about 3 per cent of the grid area.

Temperature in the regenerator is controlled by generation of high pressure steam in recycle catalyst coolers. The total steam generated by burning of coke from catalyst in the unit normally averages about 120,000 lb. per hr.

During wartime operations for the production of aviation gasoline, the unit was operated largely on straight run gas oil of 30-deg. or higher API gravity. At times, various naphthas, both straight run and cracked, were charged as supplementary charge to maximize aviation gasoline production.

Since the end of the war the charge has been gradually made heavier and for the last several months has been primarily a heavy California waxy distillate of high viscosity averaging 22-23-deg. API gravity. This heavy material is obtained by deep vacuum flashing of heavy residuums in the vacuum feed preparation unit supplemented by a furnace and vacuum tower available in an otherwise idle thermal cracking plant.

The results of cracking such heavy waxy feed stock for the production of motor gasoline are shown in Table I.

TABLE 1.
Yields and product inspections—typical monthly average.

Charge, bbl. per day	
Fresh feed	17,660
Recycle	2,292

Products, basis fresh feed	Volume, per cent	Weight, per cent
Dry gas		7.5
Propane—propylene recovered	3.8	
Butanes—butylenes	8.2	
Light catalytic naphtha	18.1	
Heavy catalytic naphtha	17.1	
Light catalytic gas oil	20.9	
Heavy catalytic gas oil	26.9	
Coke		7.9

Product inspection data	Feed stock	Light naphtha	Heavy naphtha
Gravity, deg. API	22.9	67.2	39.4
Viscosity, SSU at 100°F.	191		
IBP, °F.	480	108	267
10 per cent	659	129	285
50 per cent	795	161	325
90 per cent	934	218	392
Sulphur, wt. per cent	0.4	0.1	0.2
Aniline point, °F.	165	71	40
Carbon residue	0.2	..	..
Octane—CFR MM—clear		79	79
Octane—CFR RM—clear	..	94	93

TABLE 2.
Typical analysis of light hydrocarbon streams.

	Residue gas	Propane-propylene	Butanes-butylenes
Hydrogen	30.6		
Nitrogen	9.0		
Oxygen	Tr.		
Carbon dioxide and hydrogen sulphide	2.2		
Methane	28.2		
Ethylene	6.7	0.4	
Ethane	15.3	4.4	
Propylene	4.6	63.4	
Propane	1.8	31.8	
Isobutane	1.6		19.5
Butylenes			69.5
Normal butane			11.0

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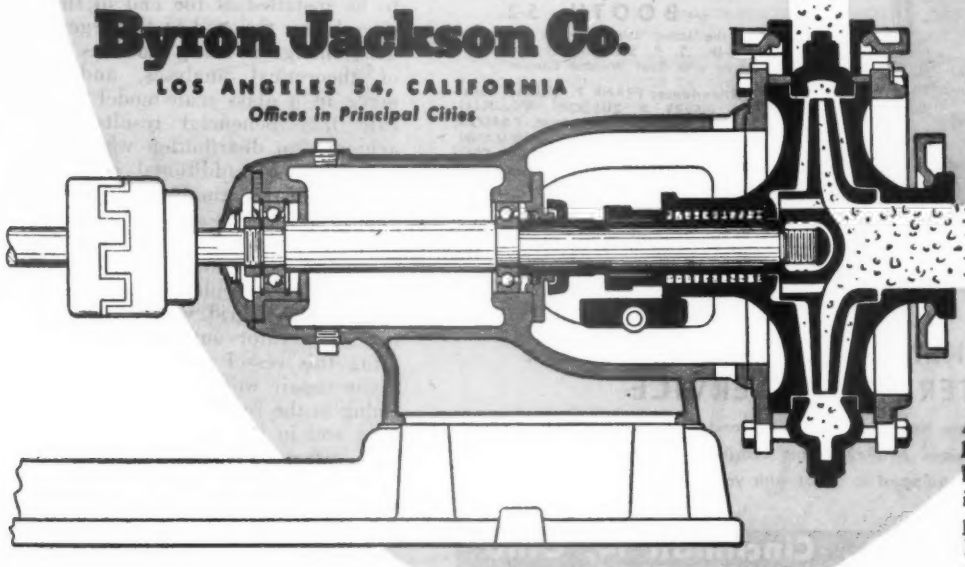

All pump parts that contact pumped liquid are of Corrosiron, as indicated by solid black cross-section areas in illustration. Sizes: 1½" to 3"; Capacities: 30 to 425 gpm; Pumping Heads: 20 to 140 feet; Speeds: 1150, 1450, and 1750 rpm.

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TABLE 3.
Typical operating conditions.

Oil feed temperature, °F.	500
Reactor temperature, °F.	949
Regenerator temperature, °F.	1105
Weight hourly space velocity	6.3
Catalyst- oil ratio	10.3
Reactor pressure, lb. per sq. in. ga.	9.1
Regenerator pressure, lb. per sq. in. ga.	1.0
Reactor holdup, tons catalyst	22
Regenerator holdup, tons catalyst	323
Total catalyst in unit, tons	760
Air rate, M. std. cu. ft. per min.	51
Flue gas analysis:	
Per cent CO_2	12.7
Per cent CO	5.4
Per cent O_2	1.7
Catalyst activity:	
Specific surface sq. m. per g.	100
Carbon on regenerated catalyst, wt. per cent	0.17

These results are for recent operations when operating on a catalyst comprised of a small amount of residual wartime synthetic catalyst to which a relatively large proportion of natural catalyst has been added.

Typical analyses of the lighter hydrocarbon fractions are shown in Table 2.

In Table 3 is shown the operating conditions when producing the products shown in Table I.

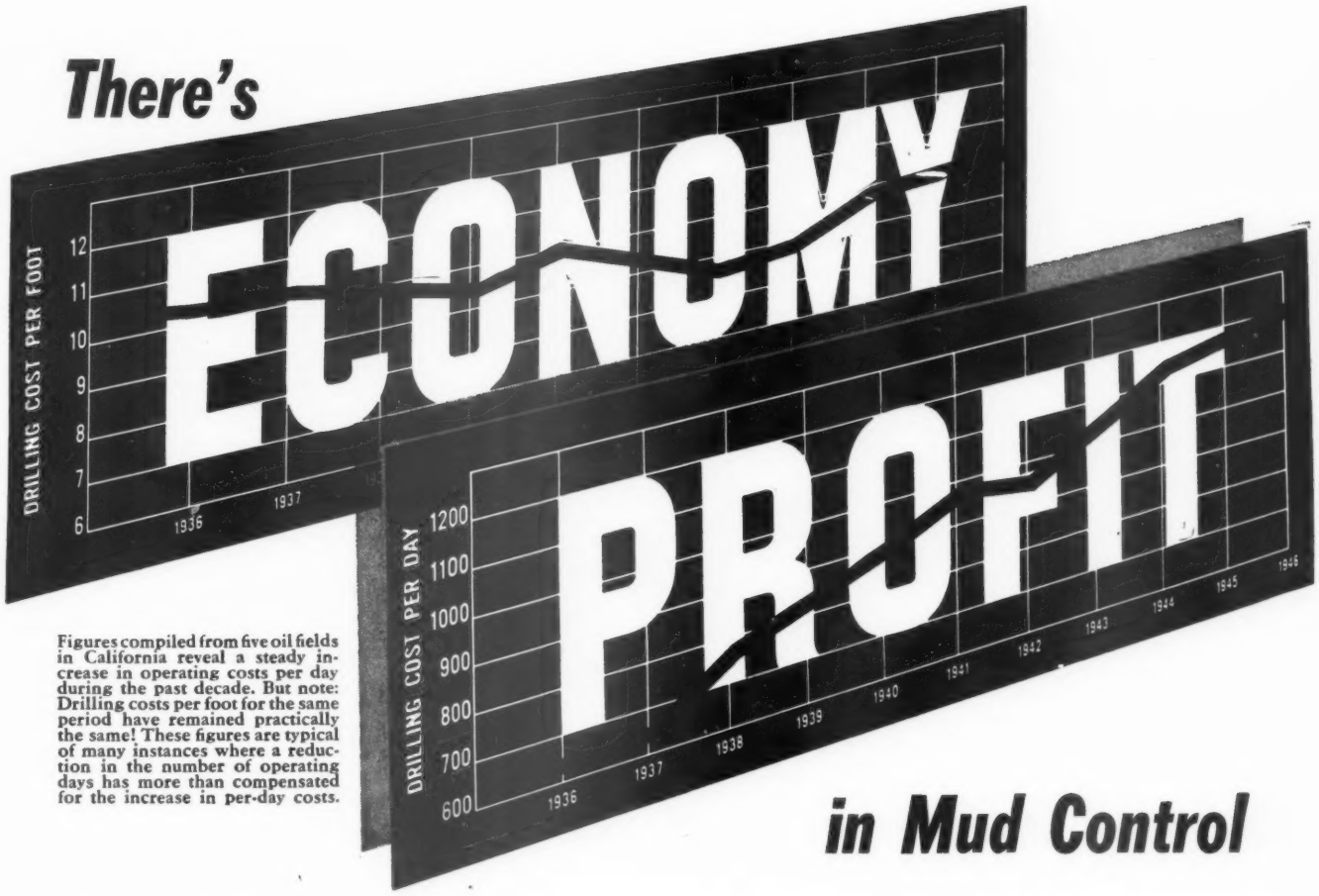
The Avon catalytic cracking unit was shut down according to schedule on the morning of September 8, 1946. The run was terminated because of failure of baffles in the Cottrell precipitator, which shorted out part of the electrical systems and caused excessive catalyst losses during the last few days of operation. Preliminary inspection of the unit shortly after the shutdown on September 8, 1946, showed that the unit was otherwise in excellent shape except for certain work that had been anticipated. The wear in the unit during the 415½ day run was so moderate that it would have been possible to continue operations for many more months had the electrical equipment been fully operable.

During the turnaround, a portion of the multiclone units will be replaced and the tubesheets repaired as necessary. A branched-pipe air distributor is to be installed at the end of the main riser below the grid in the regenerator. This change is being made as a result of theoretical analyses, and studies made in a glass scale-model that indicate that beneficial results may be achieved on distribution within the regenerator. An additional recycle catalyst cooler originally purchased for extra wartime capacity is to be installed. All ferrules protecting tubes in the waste heat boilers operating on flue gases will be replaced. A new design of restriction grid will be installed in the regenerator outlet to permit operating this vessel at a higher pressure. Some repair work will be done on the lining in the regenerated catalyst standpipe and in the flue gas line. The Cottrell precipitator will be completely overhauled during the turnaround.

The condition of the Avon fluid catalyst cracking unit after nearly 14 months' operation indicates that runs of this length are perfectly practicable.

★★★

There's ECONOMY PROFIT in Mud Control



Figures compiled from five oil fields in California reveal a steady increase in operating costs per day during the past decade. But note: Drilling costs per foot for the same period have remained practically the same! These figures are typical of many instances where a reduction in the number of operating days has more than compensated for the increase in per-day costs.

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AEROFLO, for example, finds wide use today, since it is particularly suited for mud control in deep wells . . . promoting greater efficiency of phosphates in salt cut muds . . . in muds that do not respond to regular chemical treatment . . . and where high temperatures cause rapid thickening. AEROFLO also facilitates elimination of sand.

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Pacific A.A.P.G. has fall meeting

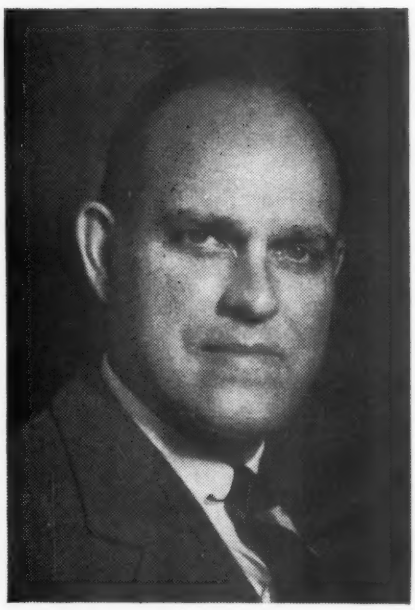
THE American Association of Petroleum Geologists, Pacific Section, held its Twenty-Third Annual Meeting on November 7 and 8, at the Ambassador Hotel in Los Angeles, and presented an unusually interesting group of papers on a wide variety of subjects related to petroleum geology and the search for oil. In addition to West Coast geologists, a number of officers and members of the national organization were in attendance, among them Earl B. Noble, Union Oil Company, national president of AAPG; Monroe Cheney, Coleman, Texas, past president; J. P. D. Hull, Tulsa, Oklahoma, business manager of the Association's monthly *Bulletin;* and J. J. Jakosky, Los Angeles, national president of the Society of Exploration Geologists.

The convention featured concurrent meetings of two affiliated groups—the Pacific Coast district of the Society of Exploration Geophysicists, and the Pacific section of the Society of Economic Paleontologists and Mineralogists. These two groups held their meetings on the morning of the 7th, while the geologists began their technical sessions in the afternoon of the same day. The opening gun for the geological boys was an informal luncheon in the Embassy Room of the Ambassador, at which E. R. "Bob" Atwill, president of the Pacific Coast section of AAPG, acting as chairman and toastmaster, introduced the national officers, including E. B. Noble, the national president, who commented briefly on the responsibilities of the regional chapters in relation to the objectives of the national organization.

J. R. Dorrance, chief geologist for The Texas Company, was the chairman of the program committee, and presided at the first technical session. His fellow members on the program committee were Wayne Loel, Burnoel Petroleum Company, who presided at the Friday morning meeting, and J. P. Matter of the British American Petroleum Company. The arrangements committee was made up of Frank B. Carter, General Petroleum Corporation; Lloyd Metzner, Signal Oil and Gas Company, and Harold Rader of Standard of California. Gordon Bell of Western Gulf handled the publicity.

The first paper presented at the geological gathering was one by Francis Sheppard, Scripps Institution of Oceanography, La Jolla, California, describing his experiences, and the general effects, of a tidal wave in the Aleutians.

The second paper was delivered by Graham B. Moody, Standard of California, San Francisco, and was a discussion of the effect of World War II on California oil reserves. In this connection, the author stated:



E. R. Atwill, Union Oil Company, is president, Pacific section, AAPG.

"The enormous demands of World War II for California oil were met successfully. Production was increased from 230,263,000 bbl. in 1941 to 326,555,000 bbl. in 1945. This is an increase of 41.8 per cent. The comparable figure for the rest of the United States is 18 per cent. During the period 1941 to 1945, inclusive, California produced 18.2 per cent of total United States oil production and 11.7 per cent of total world production. It increased its proportion of total United States production from 16.4 per cent in 1941 to 19.1 per cent in 1945. One other record of past performance is of interest: California had produced to December 31, 1945, about 22 per cent and 14 per cent of total cumulative production from the United States and the world, respectively. This performance was accomplished by development of about 245,000 proved productive acres. Average ultimate recovery from California fields is estimated to be about 44,000 bbl. per acre.

"Despite the drain on California's oil resources by World War II, production in the middle of September, 1946, was about 870,000 bbl. daily; the daily average during 1941 was about 631,000 bbl. During the period 1941 to 1945, inclusive, the discovery of new pools and new fields in California added estimated reserves equal to about one-third of production during that period."

Following Moody's paper, Professor A. I. Levorsen of Stanford University held the attention of the geologists with a dissertation on the "Time of Oil and Gas Accumulation," "A perplexing problem in petroleum geology," Professor Levorsen pointed out, "is whether the oil and gas originate at or very near the point of accumulation, or whether they have migrated in from some distant area of origin. Examples of both in situ and distant origin can be cited that seem to indicate both occur in nature.

"For those pools that seem to indicate migration from a distant source, a rough guide as to the time of the accumulation is offered. It is based on the timing of the formation of the trap into which the oil and gas accumulate—the accumulation cannot occur before the trap is formed. In considering the interval between the time of formation of the reservoir rock and the present time, most producing traps can be separated into the varying component elements that go to make up the trap as it now exists. Examples of different combinations of trap-making events are given as a guide to the time before which accumulation could not have occurred. Furthermore, the capacity of a trap is in part a function of the depth of burial of the reservoir—a phenomenon that also supports a relatively late accumulation in many pools."

The final paper of the Thursday afternoon meeting was one on the unusual subject of "Permafrost and Related Engineering Problems," by Siemon Wm. Muller of Stanford University.

On Thursday evening, the Society of Economic Paleontologists and Mineralogists convened at the Mona Lisa Cafe for a dinner meeting, at which Dr. J. Wyatt Durham, California Institute of Technology, spoke on "The Cretaceous of Colombia."

The geological sessions were resumed on Friday morning with Wayne Loel presiding, and the opening speaker was Thomas L. Bailey, Rothschild Oil Company, Santa Fe Springs, California, whose subject was, "Origin and Migration of Oil Into Sespe Red Beds."

Next came Glenn C. Ferguson, ex Union Oiler, and now a consulting paleontologist at Bakersfield, California, with a paper, entitled, "Evidence Supporting Lateral Migration of Oil, San Joaquin Valley, California."

E. J. Coenen and H. D. Hobson, General Petroleum Corporation, Bakersfield, California, ended the Friday morning forum, with a discussion, on the "Accumulation of Oil in Continental Sediments at the South Belridge Oil Field, Kern County, California." On this subject, the authors submitted data concerning the accumulation in continental sediments at the Belridge field, and exposed the structure and stratigraphy of the field,

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A. S. Holston, Tide Water Associated Oil Company, secretary-treasurer of organization.

the reservoir characteristics of the sediment, and the properties and distribution of the oil and associated waters. The lithology, organic content, and included fluids of adjacent marine sediments were discussed with the objective of making tentative suggestions on the origin, migration, and accumulation of the oil.

The Friday afternoon session was directed by W. P. Winham, Standard Oil Company of California, Los Angeles, who first introduced Wallace Pratt, Distinguished Lecturer, A.A.P.G., New York, speaking on the subject, "Petroleum on the Continental Shelves." Pratt issued a challenge to petroleum geologists in the following words:

"President Truman's executive proclamation of September 25, 1945, declaring the continental shelf contiguous to our coasts to be subject to our jurisdiction and control, fell upon the ears of a petroleum industry that in its worldwide search for new sources of supply, had already found its exploratory operations on more than one continent brought to a stop at the land's edge across which it had for years peered uncertainly out to sea. The problem of petroleum resources on the continental shelf challenges first the geologist, then the engineer. The geologist's immediate and pressing responsibility is to review his accumulated knowledge of the character of the continental shelf, and in the light of his concepts of the origin and occurrence of petroleum, to measure the adequacy of the reward that awaits the conquest of petroleum under the submerged margins of the continents to compensate the risk, effort and expense that this task poses for the engineer. In reply to this challenge to geologists, it is submitted that if the earth is viewed as a functioning organism, surely one of its normal functions since life covered its surface has been the generation of petroleum, much greater volumes of petroleum than are now believed to exist beneath the land areas of the earth should have been formed through the ages. The most likely place to search for these possible additional stores of petroleum is the continental shelf."

J. H. Beach, Independent Exploration Company, and Harry Campbell, Jergins Oil Company, next collaborated on an exposition of the "Geology of Basement Complex Edison Oil Field, Kern County," pointing out that "the pre-tertiary metamorphics in the Edison oil field have, since the discovery of this zone by H. H. McGee in June, 1945, yielded 3,330,000 bbl. of oil to August 31, 1946. Of the 103 wells since drilled into the basement during its development, all but six have been completed as commercial producers.

Discussing the Santiago pool in Kern County, California, Glenn W. Ledingham, Western Gulf Oil Company, Bakersfield, pointed out that the initial completion took place on August 1, 1945, and that since then 26 producers and 4 dry holes had been drilled. The pool is in Sections 21 and 22, T. 11N, R. 23 W, in the south San Joaquin Valley. Production was established from an upper Miocene sand, roughly equivalent in age to the basal part of the Stevens sand. The average dip is 70 deg. The developed portion of the pool is 1¾ miles long, with a maximum width of 500 ft. The north, south, and west limits have been established and development is continuing in an easterly direction.

The Ramona field of Los Angeles and Ventura Counties was the subject of a discussion by Loyal E. Nelson, consulting geologist of Los Angeles.

Concluding the Friday afternoon session was a presentation by D. F. Hewett, U.S.G.S., Washington, D. C., on "Stratigraphic and Structural Features of the Ivanpah Quadrangle, Southeastern California." Concerning the 3800 square miles, approximately, in this area, Hewett spoke from some 25 months of experience in field work.

The program of the Economic Paleontologists and Mineralogists opened with "Notes on the Stratigraphy of the Santa Maria District," by Aden W. Hughes, Union Oil Company, Santa Maria.

Then came W. L. Rothwell, Jr., Richfield Oil Corporation, Long Beach, California, discussing "The Ostracoda in Paleography."

John S. Shelton, Pomona College, Claremont, California, next delivered a definition of "The Glendora Volcanics," which may be summed up thus: "The term Glendora Volcanics has been given to the series of volcanic rocks exposed in the northeastern San Gabriel Basin, Los Angeles County, California. They consist of flows, tuff breccias, and tuffs ranging in composition from olivine basalt to glassy rhyolite or dacite, the most abundant being andesitic flows and pyroclastics. Thicknesses reach at least 2000 ft. in exposed sections and about 3500 ft. in wells. Luisian foraminifera and fish scales from sediments interbedded with upper members of the volcanics indicate that they are probably largely of upper middle Miocene age."

The concluding paper of the session was "Highlights of Washington and Oregon Biostratigraphy," by R. Stanley Beck, consulting paleontologist, Bakersfield, California. In this paper, the biostratigraphy of type and classical localities of Washington and Oregon were discussed. Special emphasis was given to the Astoria, Cowlitz, Olymic Peninsula, and Coos Bay basins. Strata from Devonian to recent are known from these areas, and have a combined thickness of more than 30,000 ft. These basins as well as others are possible sources of future oil, in which connection, the author pointed out the unfavorable as well as the favorable geologic indications.

At the time of writing, the papers presented at the meeting of the Exploration Geophysicists were not available. Included in the program, however, was a round table discussion on the much debated subject of "Multiple Reflections." This was lead by T. P. Ellsworth, Richfield Oil Corporation, Bakersfield, and provoked a lively participation. E. L. Erickson, Continental Oil Company, Los Angeles, gave a "Case History Wasco Feld, California," and was followed by Phil Gaby, Standard of California, San Francisco, in a paper, entitled, "Correlation Record Grading." The windup of a very successful meeting was an interesting dissertation on the "Bikini Atom Bomb Experiments," by R. B. Moran, Jr., U. S. Navy Research.

As a finishing touch to the annual meeting, a well attended dinner dance was held in the Embassy Room of the Ambassador Hotel on Friday evening.

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Pumphouse is shown in left foreground, dehydration plant in background at right, and product storage tanks in far background.

New cycling plant for Carthage

By **FRANK H. LOVE,** *Managing Editor*

EXCLUSIVE

With procurement of materials for any construction project still a major problem, Lone Star Producing Company and Rogers Lacy Interests surmounted this obstacle in the erection of a cycling plant in the Carthage field, Texas, by moving salvageable equipment from a field where gas production had declined to a point of non-economical operation and supplementing it with certain new equipment to erect a plant of modern design.

The plant is designed for a total throughput of 100,000,000 cu. ft. of gas a day. Half this volume will be processed through the high pressure side of the plant when in full operation, and cycled, i.e., the residue returned to the producing formation. The other 50,000,000 cu. ft. will be processed through the low pressure equipment and discharged to pipe line for commercial consumption. In connection with the latter operation a dehydration plant using diethylene glycol has been provided. The dehydration plant has two contactors and can handle the entire capacity of 100,000,000 cu. ft. a day. This can be accomplished by shutting down cycling operations and routing all intake gas through the dehydration unit and into the pipe line. Under ordinary operation, however, the maximum throughput of the unit will be 50,000,000 cu. ft. a day.

● **Cycled gas.** Gas to be cycled is first treated in a high-pressure absorber at 2150 lb. The residue from this absorber is compressed to approximately 3550 lb. by two 650-hp. angle-type compressors and injected into the producing formation. Each compressor unit has two cylinders of forged steel, which have a 4-in. bore and 15-in. stroke. Compression is in single stage. An interesting feature of the suction and discharge lines to the compressors is the fact that the loops enter the headers at a 45-deg. angle instead of the usual 90-deg. angle, which virtually eliminates vibration. This arrangement is shown in an accompanying illustration.

● **Pipe-line gas.** Upon arrival at the plant, gas intended for discharge to pipe line is treated in a 1200-lb. working pressure absorber, the operating pressure of the absorber being whatever is required to feed into the Lone Star Gas Company's transmission system. Residue gas from the pipe-line absorber is

dehydrated after it leaves the unit and before it enters the pipe line.

● **Processing.** Rich oil upon leaving the absorbers is taken to the distillation unit, which consists of heat exchangers, steam-heated preheater, primary still, and combined secondary still and dephlegmator. The primary still operates at a pressure of 200 lb., stripping out all non-condensable vapors from the rich oil. The secondary still and dephlegmator operates at 400° F. base temperature and 250°F. top temperature and at a pressure of 50 lb.

All overhead from the dephlegmator is totally condensable.

Condensed liquids from the primary still overhead, as well as the dephlegmator overhead, are pumped as raw feed to the depropanizer. Overhead vapors from the depropanizer are used as fuel, whereas depropanizer bottoms are fed to the debutanizer. Commercial butane is here taken as the overhead product and gasoline as the base product.

The plant is also designed to manufacture kerosine from a sidestream leaving the dephlegmator.

● **Auxiliaries.** A 12-car loading rack has been installed about seven miles from the plant, and at this site facilities are available for making leaded gasoline. At the loading rack there are also three 10,000-bbl. tanks for gasoline storage and two 650-bbl. tanks for butane.

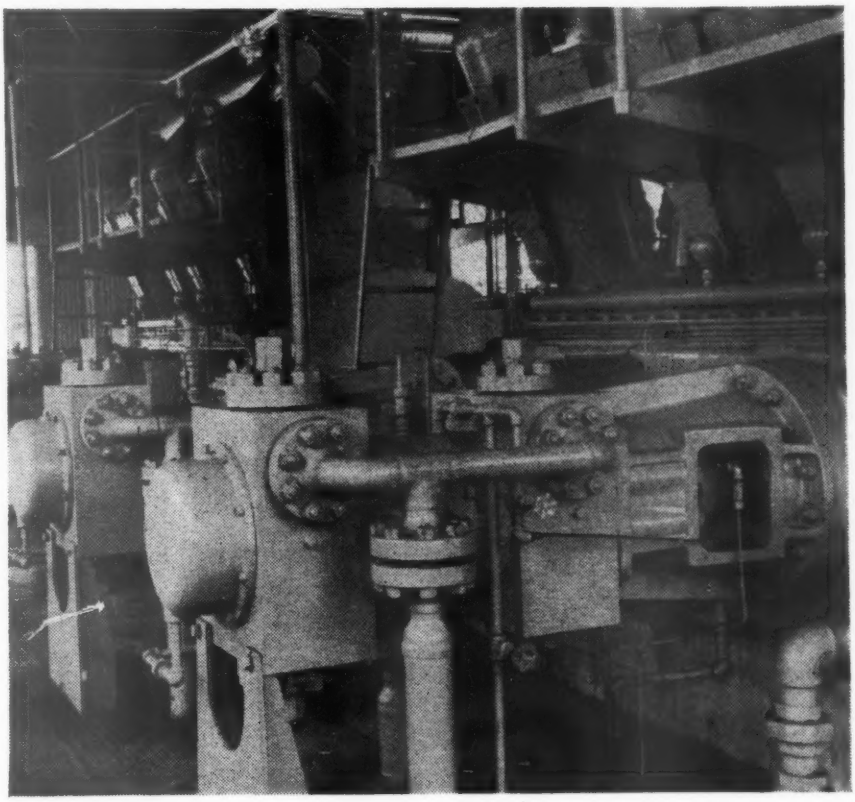
Storage facilities at the plant consist of 4000-bbl. capacity for gasoline, 3000-bbl. capacity for kerosine, and 650-bbl. capacity for butane.

A 22-bay cooling tower of the natural draft type serves the gasoline and cycling plant, and a smaller unit of 5-bays the dehydration plant.

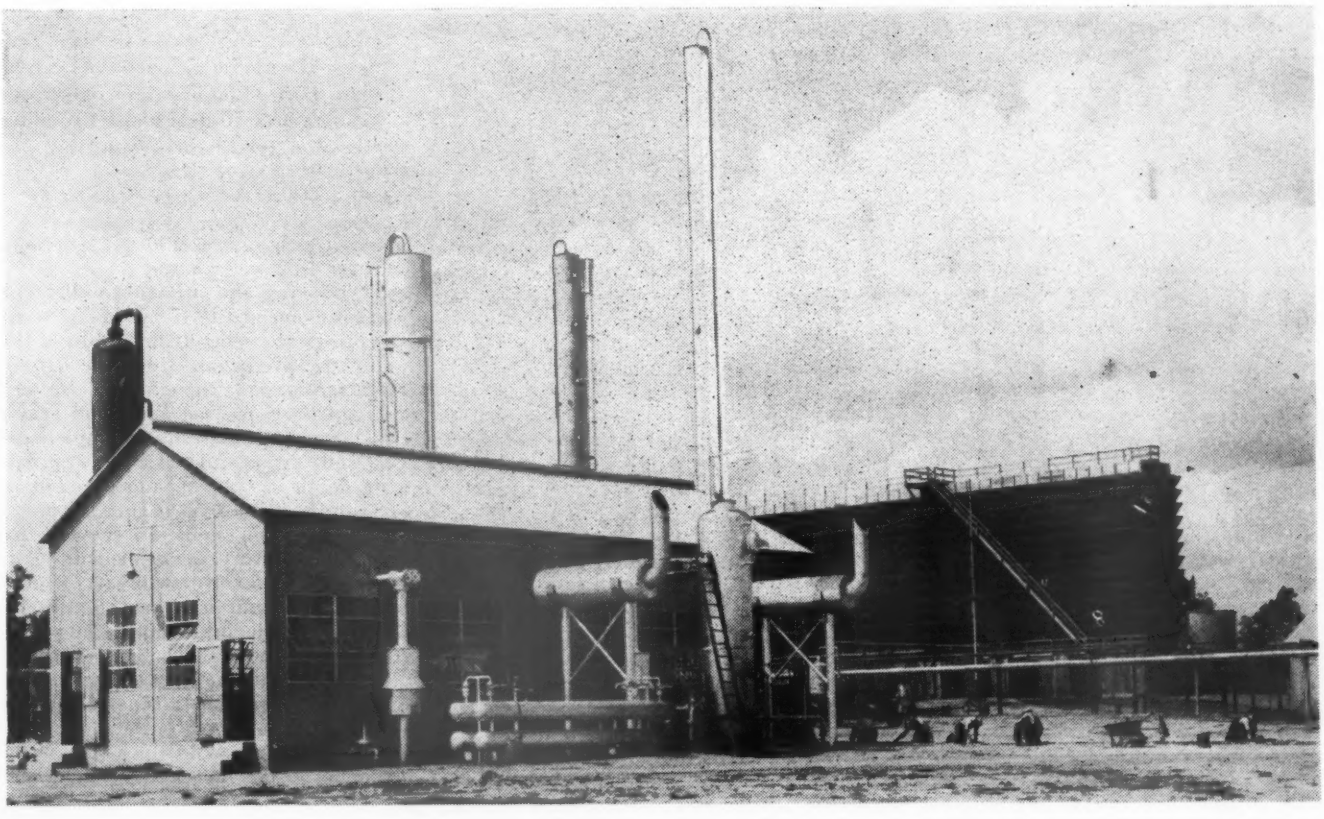
To provide electricity for lights, two 25-kw. generators are available.

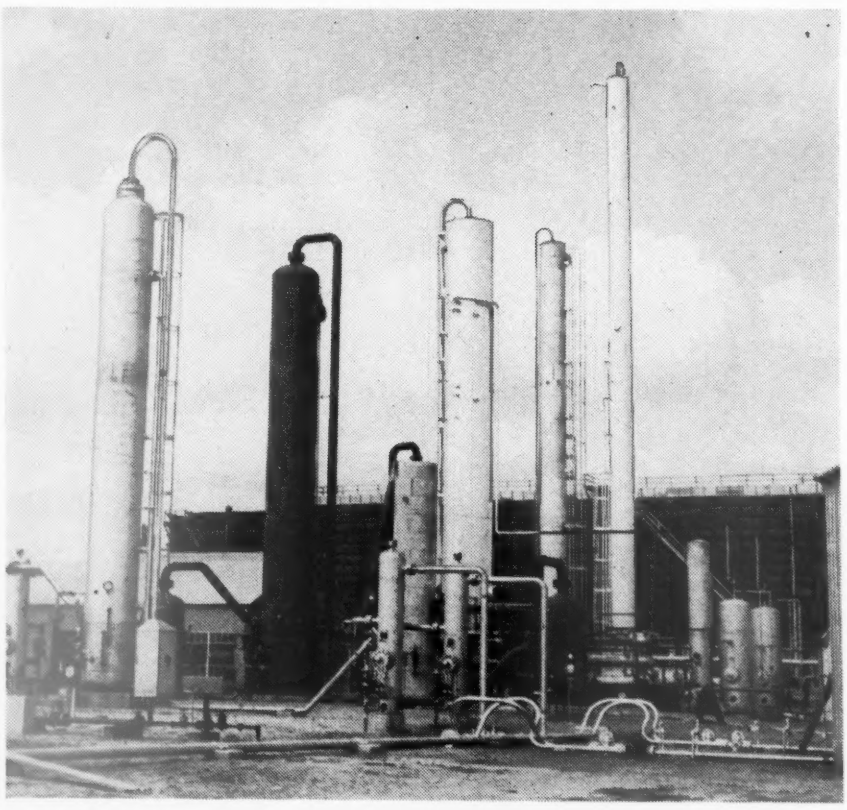
As a source of steam utilized in processing and as power for the steam turbines, two new 258-hp. water-tube boilers have been installed. Each unit generates 21,000 lb. of steam an hour at an operating pressure of 300 lb.

Two water wells, each 300 ft. deep, supply plant requirements. They are



***Right*—Gas is compressed to approximately 3550 lb. by two 650-hp. compressors and returned to the producing formation. *Below*—Compressor building, and in background the cooling tower.**





***Above*—General view of processing equipment. In distance cottages that house the operating personnel can be seen. *Left*—Loops enter compressor headers at a 45-deg. angle to reduce vibration (right foreground).**

pumped at a rate of 100 gal. per min. each by deep well pumps.

● **Producing and injection wells.** The plant is connected to 15 producing wells and others are being drilled. Most of the wells are producing from the Upper Pettit formation, although some are producing from the Lower Pettit and Travis Peak. Some, also, are dual completions. The wells are completed at an approximate depth of 6000 ft. and the shut in pressure is about 2650 lb. per sq. in.

Two injection wells are now being used and a third is being drilled.

● **Owners and constructors.** As stated, the cycling plant is owned jointly by Lone Star Producing Company and Rogers Lacy Interests. The dehydration plant is owned by the Lone Star Gas Company. Design and construction of all installations were by the Lone Star organization and plant operation is by personnel of the same organization.

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Nine-speed drilling rig air-operated

By **JULIAN P. VAN VORST**

FIG. 1

THE rig described herein is one of two owned and operated by the Thompson-Carr Company of Houston in the Odessa, Texas, area. Another similar rig is being operated by Al Buchanan of San Antonio near Pleasonton, Texas.*

EXCLUSIVE

Flexibility was the main objective in designing this rig, and this has been accomplished by the use of a nine-speed transmission between the power units and the drawworks. This allows the slush pump, or pumps, and rotary to be operated at various speeds to suit many conditions, or all horsepower can be used for hoisting when coming out of the hole.

A single hand wheel controls all nine speeds, and it is only necessary to turn the wheel backward or forward to obtain the speed desired. It is not necessary to throttle the engines or disengage any other mechanism while changing speeds. The time required to change from one speed to another is about four seconds.

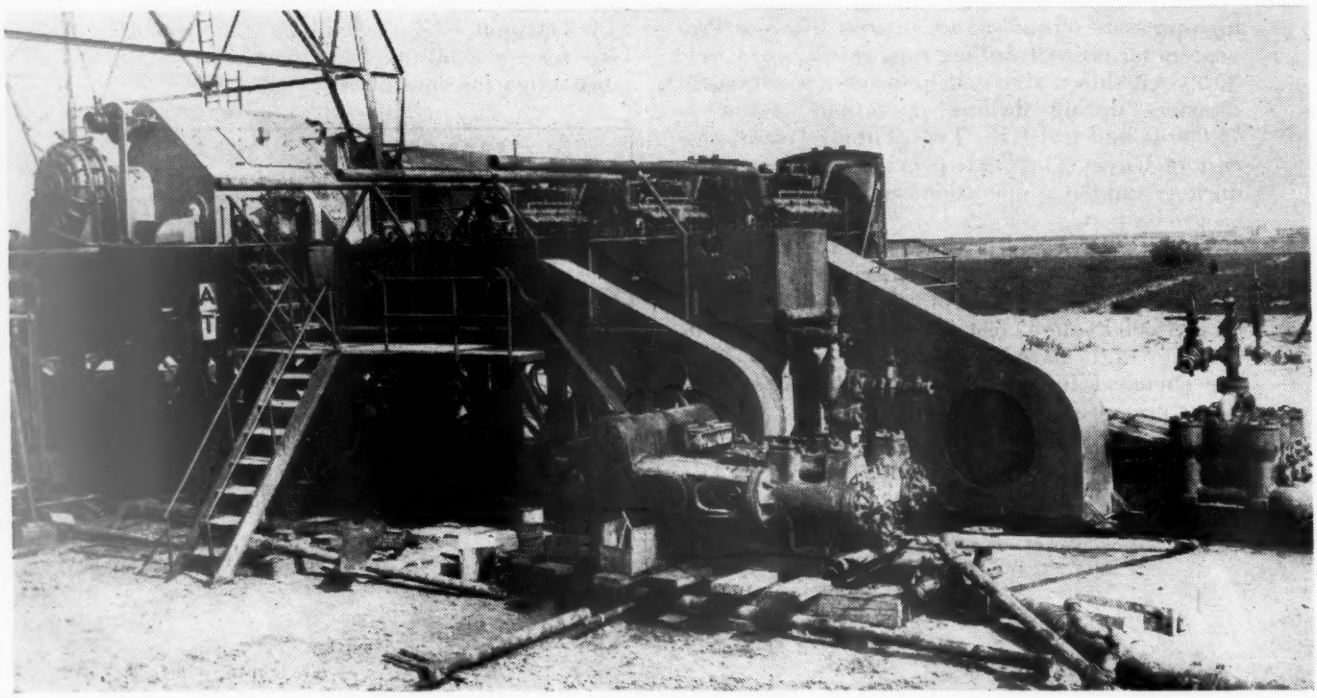
● **Controls are simplified.** To further simplify the operation, a single valve controls the two mud pumps. This valve will engage either No. 1 pump, or No. 2 pump, or both pumps depending on the position of the valve control handle. The compound clutches are operated by separate valves on the control panel permitting any combination of engines desired.

The rig consists of the following units: Three Le Roi V-12 gas engines of 330 hp. each, one compounding unit through which the power of the engines is transmitted to the slush pumps and transmission, one Clark triplex slush pump 7¼ in. by 12 in. for drilling, one nine-speed transmission, one Ideco drawworks with hydromatic brake, and one Ideco rotary.

These units and their relation to each

*Both rigs were sold by C. J. Colby of Republic Supply Company, Houston.

FIG. 2



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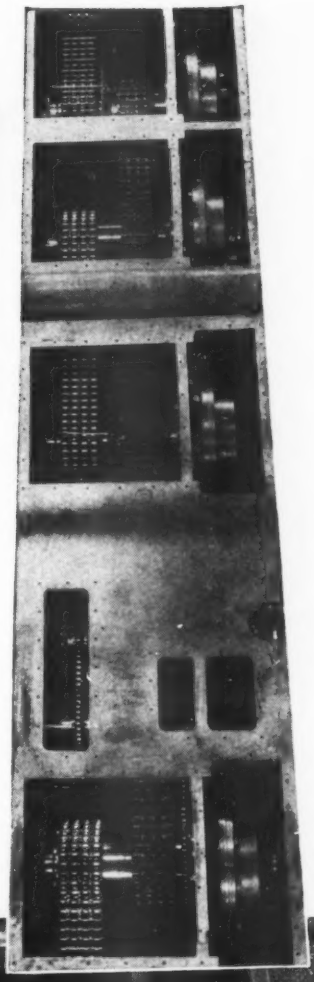

This new Clark PR-1000 rig . . . with nine drum and rotary speeds forward and reverse . . . probably has more speeds than any other mechanical rig ever built. And it's chained 100% with LINK-BELT SILVERLINK! The Clark rig is designed for greater flexibility and more selective speeds. All nine speeds are controlled by a single hand wheel. The entire rig is oil-bathed. All sprockets are machine cut-tooth. RC 140—1¾" P. Double width on the rotary drive . . . RCF 120—1½" quadruple on all transmission drives . . . 1½" sextuple width on the drive from the transmission to the drawworks . . . RCE 160—2" pitch triple width on the drum drive . . . RC 160—2" pitch single width on the cathead shaft drive. Fuel pumps are driven with RC 60—¾" P and RC 80—1" pitch single strand.

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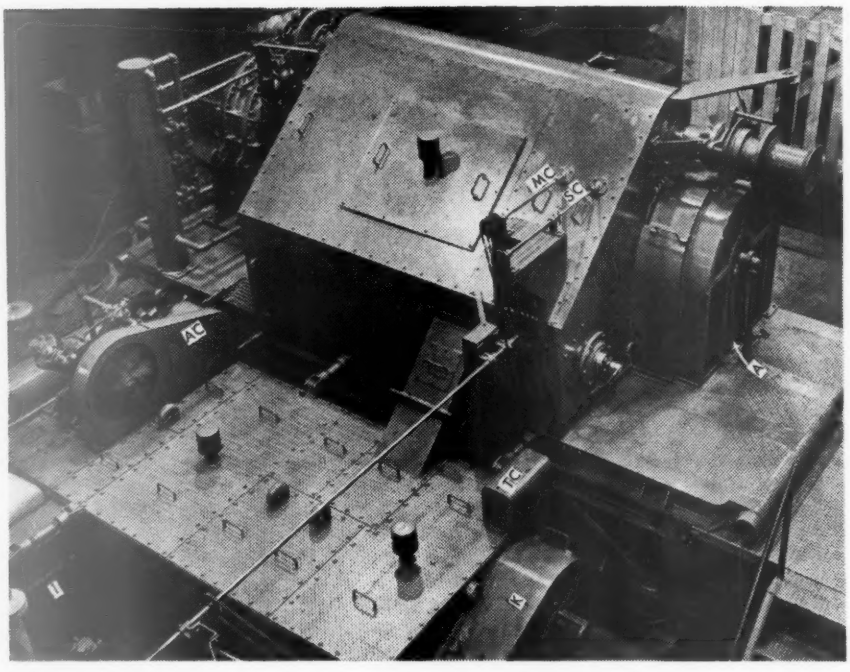


FIG. 3

other can be seen by referring to Figs. 1 and 2. Fig. 1 shows the Le Roi engines mounted on skids with radiator, fan, and clutch as single units and connected through gear type flexible couplings to the driving shafts of the compounding unit (1). The transmission is shown at 2, the connection to the drawworks at 3, the drawworks at 4, one slush pump drive at P-2, and the other pump drive at S-1. Fig. 2 shows the side view with the pump drives connected.

By referring to Fig. 4 the construction and arrangement of the compounding unit can be seen. The clutches E-1, E-2, E-3 connect and disconnect the engines from the unit. P-1 is the clutch for the slush pump drive at S-1. The clutch for the other pump drive is not shown in Fig. 4, but is in the compartment housing shown at P-2, Fig. 1. These clutches are friction clutches operated by air at 100 lb. per sq. in. and controlled by the driller at his position at the drawworks.

● **Chains differ only in length.** The chains used are the same size and pitch and except for length are interchangeable. With this unit the two slush pumps can be operated at different speeds. Two engines can drive one pump and the remaining engine can drive the other.

Clutch sprockets are mounted on tapered roller bearings and the shafts on self-aligning bearings.

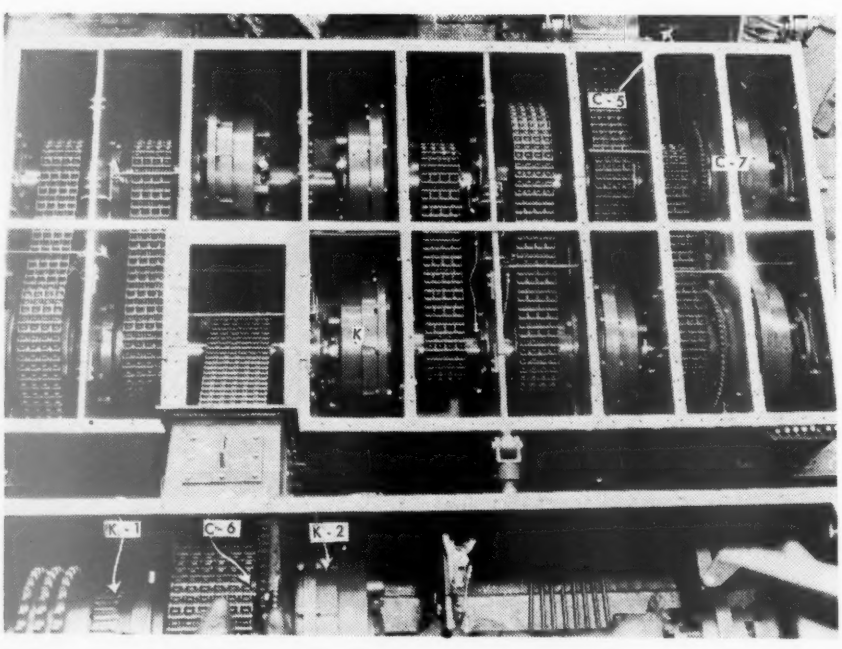
Bearings are pressure-lubricated, and the chain links are sprayed with oil supplied by oil pumps in the case, which are driven by chains shown at points indicated in Fig. 4. Three pumps, one for each engine shaft, are supplied so that ample oil pressure will be available when only one engine is running.

The water pump is shown at the side of the compounding case at P, Fig. 4. This pump supplies water for cooling the brake drums. Power to drive slush pump No. 2 is delivered through chain C-1, and connection to the transmission is through chain C-5, Fig. 4.

All clutches are separated from chain compartments by partitions so that the clutches are protected from the oil spray in the chain cases.

Fig. 5 shows the transmission with its arrangement of chains and clutches. There are seven clutches and nine speeds available. One clutch not shown in Fig. 5 is shown on outside of casing at K. Fig. 3. Chain C-5 delivers the power to the transmission from the compounding unit, and chain C-6 transmits it to the drawworks. The driving shaft to the drawworks is divided and the two halves are connected and disconnected with clutch K, Fig. 5. This accounts for the additional speeds available.

FIG. 5



● **Cathead and drum shafts can be neutralized.** K-1 is the main jaw clutch. It is controlled by compressed air. This clutch controls the drawworks cathead line shaft and hoisting drum. With this clutch out, the rotary rotates alone, thus preventing the useless turning of shafting members not being used.

Clutch K-2 controls the rotary drive. The reverse gear mechanism is inside the drawworks, and it is controlled by an air valve on the driller's control panel. All nine speeds are available through the reverse gears.

The chains used are the same as in the compounding unit and are, with the exception of length, interchangeable. The same type of bearings, chain lubrication, and bearing lubrication are used as in the compounding unit, but only one oil pump is provided.

The transmission clutches, as in the compounding unit, are the same size, except in places where more torque has to be transmitted. Two friction plates instead of one are used in these places.

Figs. 3 and 6 show the drawworks and driller's controls. Fig. 3 is a rear view of the drawworks.

The motor control sprockets, chains, and shafting are shown at MC. This is an assembly of three concentric shafts with a sprocket on the end of each and connected to the engine control shafts by chains.

The transmission control, selection of speeds, is shown at TC. This is a special air valve for controlling the clutches in the transmission and is rotated by turning shaft SC with control wheel W at central panel in Fig. 6.

Fig. 6 shows a front view of drawworks. The hoisting clutch and control pedal for the clutch are indicated by the letter H, the spinning line clutch lever S, and the breakout cathead is marked B. R is the case for connection with the rotary chain case. L indicates the brake lever, which is very easily operated and has a simple locking device that is very effective. By simply pressing the lever down farther after applying the brakes, the brakes are locked.

The brake equalizer is shown at E, and the screw for taking up wear is

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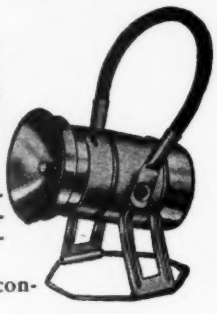

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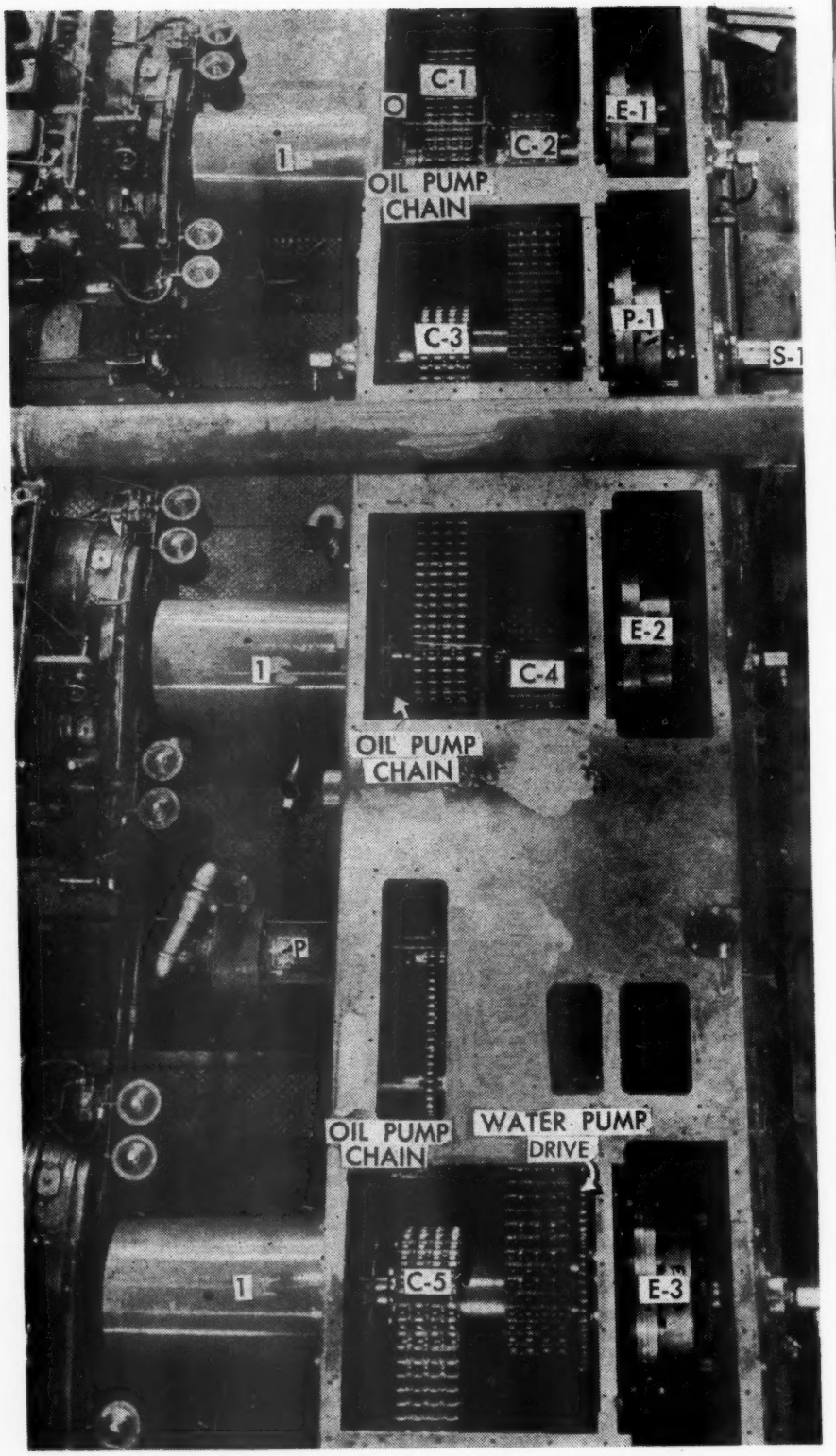

FIG. 4

marked A. The hydromatic brake HB is, on the late models, connected and disconnected to the drumshaft by an air-controlled clutch.

Fig. 9 shows the controls for the operation of the rig. W is the transmission speed control. By rotating the wheel clockwise from the position shown, higher speeds are engaged. The highest speed is shown just to the right of its present position. When the pointer is between any two speeds on the dial no speed is available. T is the throttle control with three wheels that can be tied together as one.

This type of throttle control permits the driller to run the second or standby pump with the rear motor at various speeds for mixing mud or jetting pits while drilling ahead with the two front motors and pulling the drilling pump at full speed.

The lever PC controls the pump clutches and has the following posi-

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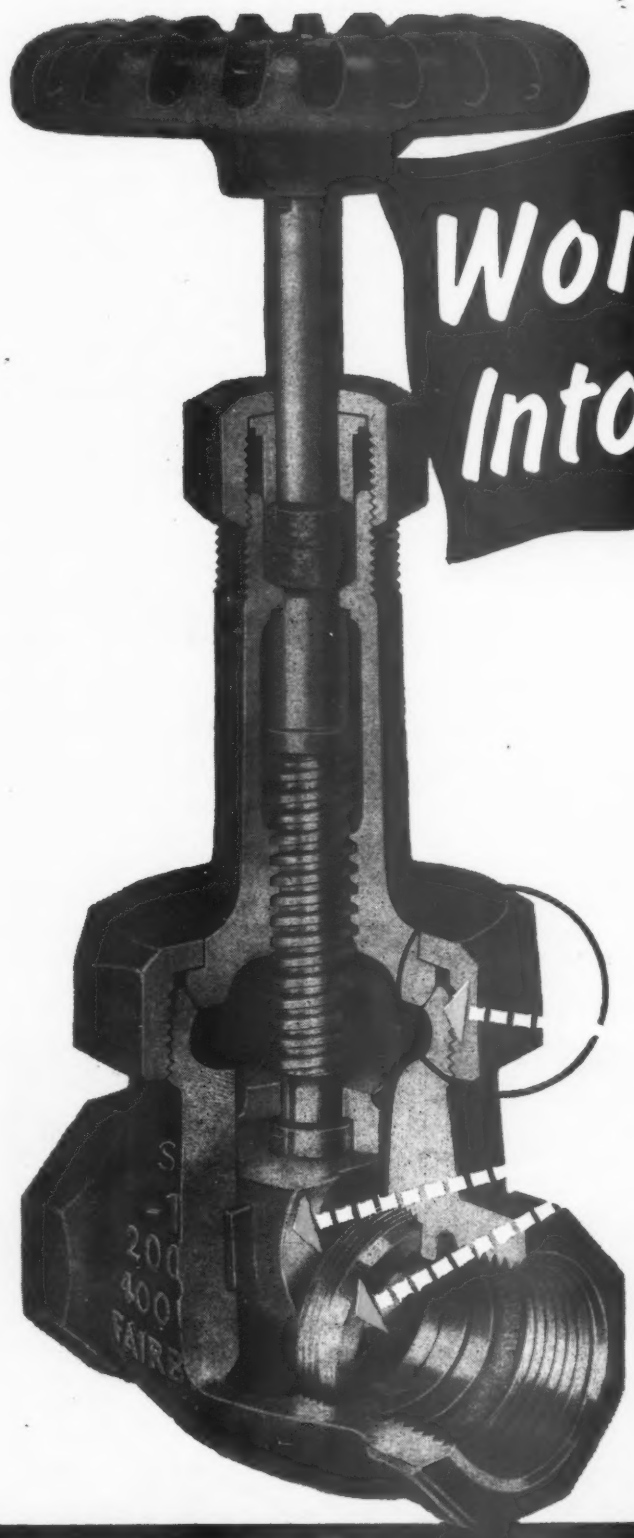

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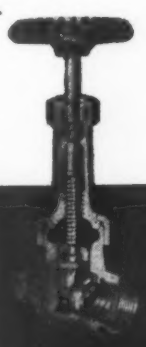

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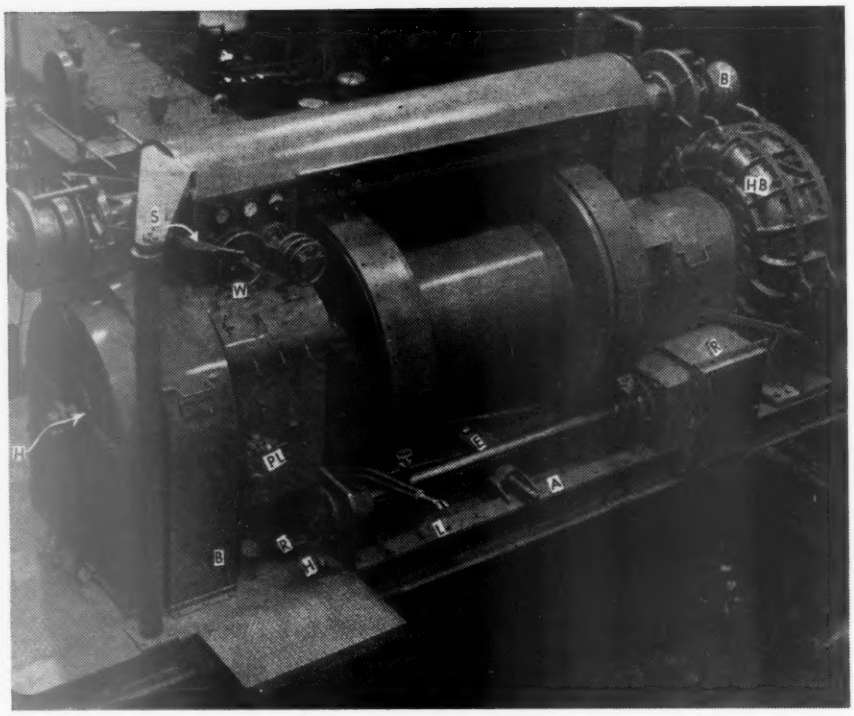


FIG. 6

tions: Pump 1, neutral, pump 2, both 1 and 2. E-1, E-2, and E-3 control engine clutches, 1, 2, and 3. JC operates the main jaw-clutch for controlling the drive to cathead and drum shafts. HDR is the hoisting drum reverse. HB is the hydromatic brake, and RR is the rotary reverse. SR is the sand reel control. Pedal B is for breaking out cathead. R is for the rotary clutch (note the latch). H is for the hoisting clutch shown at H, Fig. 6.

The gages at the top right (VG) are connected to intake manifolds of the engines. By adjusting the throttles the vacuum in each is equalized, and the horsepower output of each engine thus made equal. OP and AP are oil and air pressure gages.

The dial gages shown at TM are for tachometers, but they are not used on this particular rig. They also may be used in connection with exhaust pyrometer where diesels are used.

The complete rig consists of six major assemblies: (1) Drawworks, (2) nine-speed transmission, (3) three engine compound unit, (4) three engines up to 330 hp. each, (5) substructure, (6) two 7¼ by 12 mud pumps.

The drum spool is 30 in. in diameter and 45½ in. long. This large diameter and long drum center tends to reduce wire line wear. When six lines are strung in the derrick there is only one cutback (two layers of wire line on the drum) when pulling 90-ft. stands. There are two cutbacks when using eight lines pulling 90-ft. stands.

The brake flanges are 52 in. in diameter and 10 in. in width. The brake bands are lined with standard API brake blocks 1⅛-in. thick. The brake bands are designed to use about 90 per cent of the brake flange area.

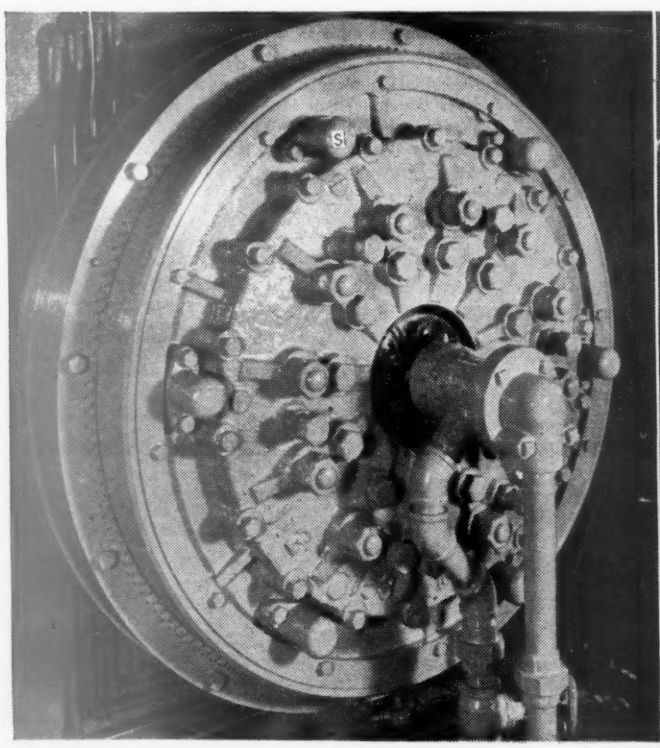
By referring to Figs. 7 and 8 the construction of the clutches can be appreciated. Fig. 7 shows the hoisting drum clutch H, Fig. 6, and Fig. 8 is the one on the outside of the transmission at K in Fig. 3.

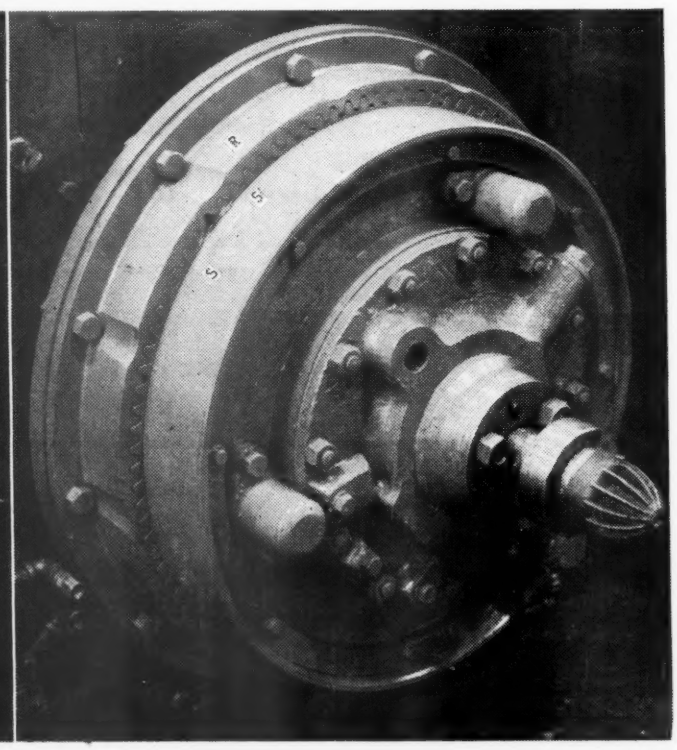
Instead of the pressure plate being pressed against the lining by toggle joint and lever action, the pressure plate acts as an annular piston or ring forced against it and held in place by 100 lb. air pressure. Special packing fitted to the annular piston prevents the air from escaping. When the air is released special springs return the ring to its released position.

The outside of the hoisting clutch is shown in Fig. 7. The piping to the center is for the brake-drum cooling water. Air connections are shown at A, Fig. 3. Releasing springs are situated under S, Fig. 7. The smaller clutch is shown in Fig. 8. These clutches are designed to provide easy removal and replacement of the lining. Fig. 8 shows the division of friction ring into two halves, S and S1. ● **Clutch ring is easily replaced.** Driving ring R can be unbolted and slipped

FIG. 7

FIG. 8





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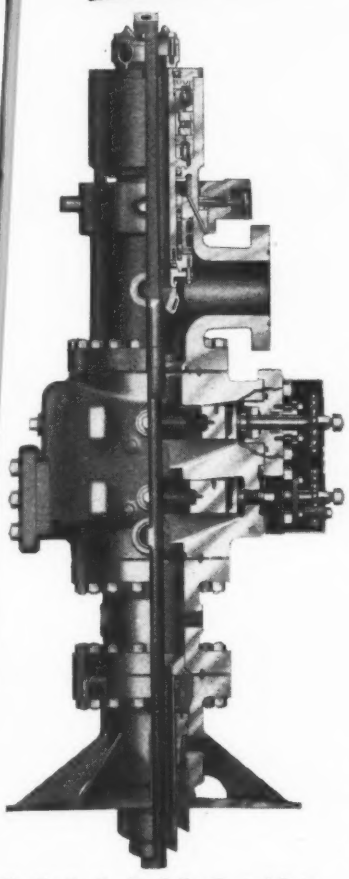
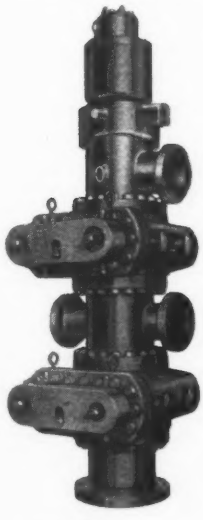


The Shaffer Double Cellar Control Gate *(above)* and two Shaffer Type 46 Cellar Control Gates *(below)*—both hook-ups with Shaffer Combination Rotating Blow-out Preventer and Stripper on top



Shaffer Rams stay where set— no secondary safeguards required!

WHEN emergencies threaten, you want a control gate in your cellar that closes—and *stays* closed—without any auxiliary locking devices or extra operations to worry about. And you *get* this positive, fool-proof operation in Shaffer Control Gates because Shaffer rams operate by *positive* mechanical screw feed. They automatically stay in the position they are set *without any further safeguards on the part of the operator*. Therefore, only ONE quick operation is required to both close the Shaffer gate . . . and *keep* it closed!

Think what this fool-proof feature means in protecting the safety of your well during the excitement and rush that accompany a threatening blowout. No auxiliary closing devices to operate —no risk of the gates opening under severest pressure conditions!

Yet, when it is desired to open Shaffer Gates, they open quickly and easily!

Six Other Shaffer Advantages

Rams that *automatically* stay in the position they are set without auxiliary devices are just one of the unique Shaffer advantages that have made these gates the outstanding choice for modern pressure control protection. Check these additional Shaffer features . . .

1. **CELLAR-SAVING COMPACTNESS**—Minimum height reduces cellar requirements, saves rig-up time, cuts installation costs!

2. **EASY RAM CHANGES**—Rams can be completely changed in the Shaffer Gate by removing just ONE end cover!

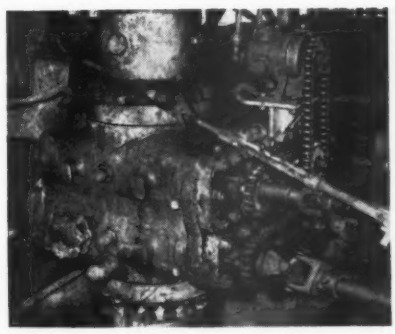
3. **SIMPLE INSTALLATION**—No complicated piping or space-wasting pressure manifolding is required for Shaffer Gates!

4. **POSITIVE MECHANICAL DRIVE**—Ram operation is quick, simple, direct and fool-proof.

5. **EQUALIZED RAM PRESSURES**—The higher the well pressure, the tighter Shaffer Rams seal off!

6. **POWER OPERATION**—Choice of air, hydraulic, electric and steam power drives—in addition to manual operation—are available for closing and opening Shaffer Gates, assuring maximum adaptability to *any* operating condition.

Shaffer Cellar Control Gates are available in a complete range of sizes from 6⅜" to 21½". There is a size to meet *your* requirements.



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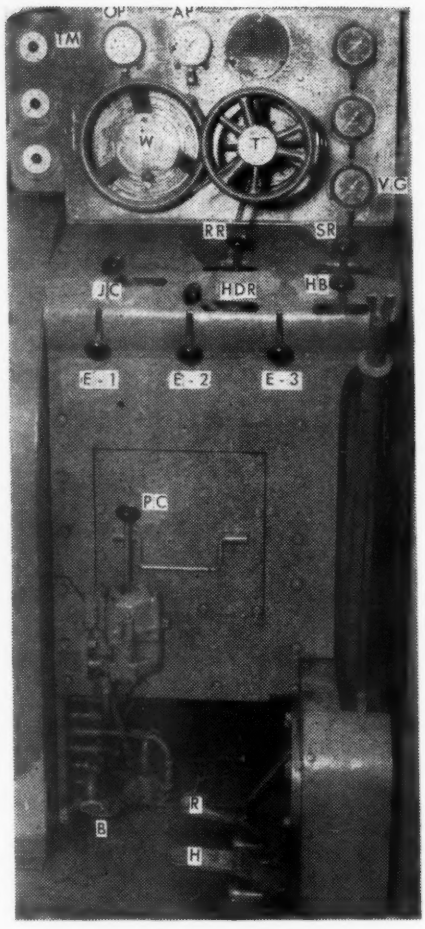

FIG. 9

back. This allows the halves S and S1 to be removed when the clutch is in released position. Thus new or relined halves can be installed easily in about four hours time.

The clutch has been designed so that the air volume within the clutch may be kept at a minimum. This tends to reduce the time of engagement and the time necessary to release. By adjustment the clutch can be completely locked thereby eliminating other means of clutching should the clutch become inoperative within itself.

The air compressor is a two-cylinder, two-stage, air-cooled unit, and it is driven from the transmission by a single chain. It is indicated by AC in Fig. 3 and Fig. 1. The two air tanks are shown at AT in Fig. 2. These tanks are kept filled with air at 100 lb. per sq. in. pressure.

To supply one engine clutch with sufficient air until the compressor could feed the system, a hand air pump was provided. This has been supplanted by a compressor driven by an auxiliary light plant.

This rig has been in continuous service since August, 1945, and has had no shut downs so far. It is heavy, which is necessary for 10,000 ft. and deeper wells, but it can be torn down in about two days and be set up in about four. The time required to haul it from one location to another varies with the distance, the weather conditions, and the terrain.

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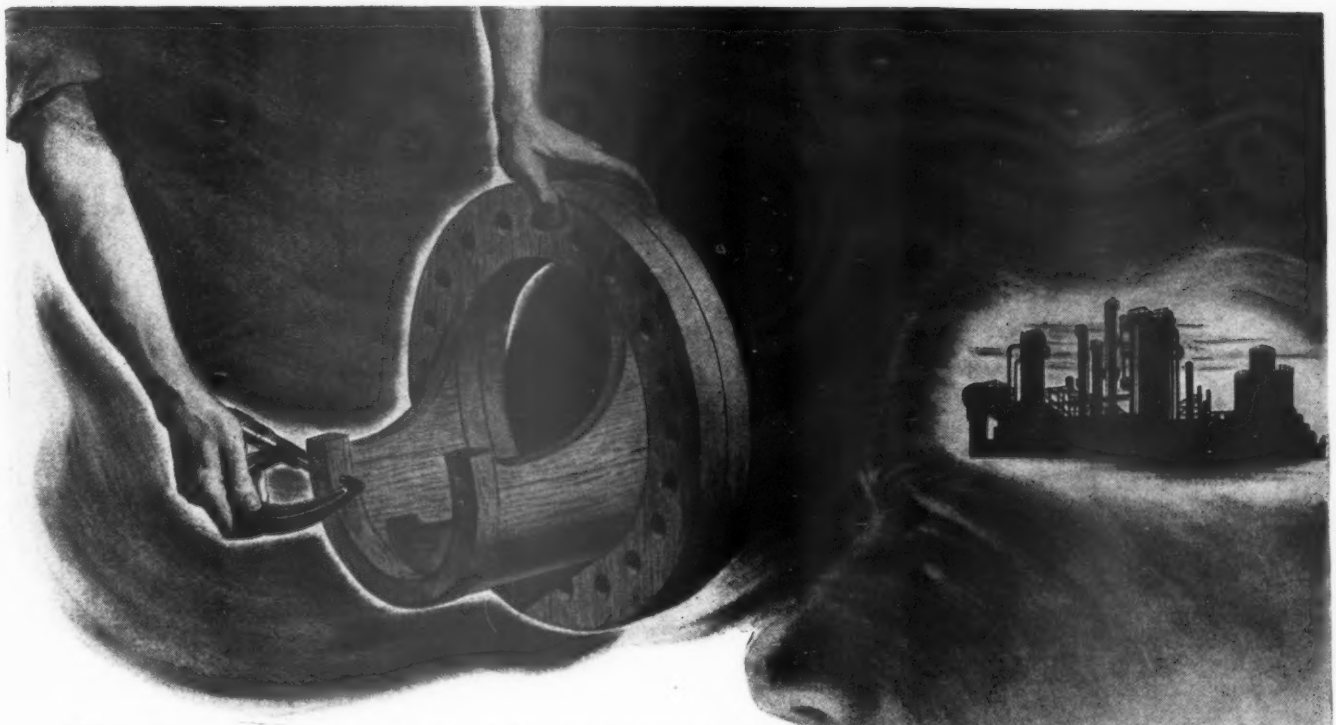

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Plastic coating inside surface of drill pipe to combat corrosion fatigue failures

By **L. E. TRISHMAN,** *Chief Research Engineer,* Spang-Chalfant Division of The National Supply Company

EXCLUSIVE

THE need for some means of combating corrosion fatigue failures in oil well drill pipe has been recognized by engineers of the Spang-Chalfant Division of The National Supply Company for some time. Corrosion fatigue failures were first brought to the attention of our field engineers in 1935. From then on, as the failures became more frequent, a close study of the contributing causes was made. It was found that certain conditions of operation contributed to early failure by corrosion fatigue, especially when drilling was being done in certain areas. When these conditions were corrected, corrosion fatigue failures continued to take place although not so soon and not so frequently.

We were not satisfied with a mediocre improvement brought about by improved drilling conditions only, but we wanted to eliminate corrosion fatigue failures entirely if such a thing were possible. Consequently, in 1940, a research program was begun in our research laboratory to find a method to stop the corrosive attack of the drilling mud and the resultant pitting of the inside of the pipe, which almost invariably resulted in corrosion fatigue failures.

During the war this problem became of secondary importance and not as much progress was obtained as we would like to have had, but now we believe we have a solution to the problem. Although probably not 100 per cent effective, the results of field trials of pipe internally coated with a chemically resistant plastic have been very convincing thus far regarding the protection the plastic coating provides against corrosion fatigue failure.

Fatigue failures, and in many cases notch fatigue failures, can be prevented by careful handling and use of the pipe. Corrosion fatigue failures can be minimized to a great degree by not overloading the pipe during drilling, but no amount of careful handling or care in drilling will eliminate corrosion fatigue failures as such. The only way they can be stopped is to stop the corrosion. The problem of preventing corrosion fatigue failures has been approached by us in two ways:

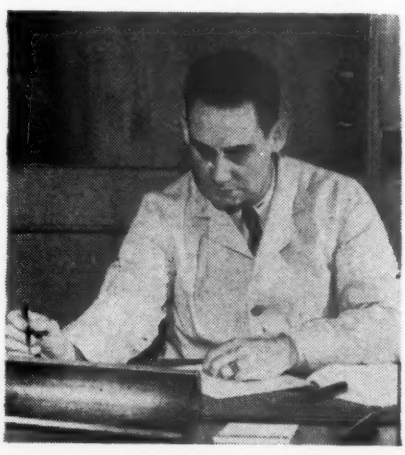
1. *Treat the drilling mud in such a way that its corrosiveness toward steel will be minimized.*
2. *Coat the inside of the pipe with some protective material so that the corrosive drilling muds cannot come in contact with the pipe where corrosion fatigue failures start.*

After some investigation and consultation with mud treating and corrosion engineers, about a year ago, our field engineers suggested to the drillers the addition of an inhibitor to drilling muds to retard corrosion. Sodium chromate up to about 2000 to 3000 parts per million of mud was tried and found effective. Drilling bits and pipe came out of the hole bright, clean, and with a frosted appearance as though the parts had been chromium plated. Drillers have reported fewer corrosion fatigue failures when the inhibitor has been used and seem to be in favor of it; however, the field tests to date have not been conclusive as to its benefits.

It has been difficult at times to obtain the chromate salt in large enough quantities and sometimes the concentration has been permitted to drop by dilution and by mud loss. The presence of an inhibitor in the mud requires a careful check by a mud chemist at frequent intervals to make sure the inhibitive values have not been lost.

The second method of approaching the problem required considerable research and experimental work. It appeared that coating the outside as well as the inside of the pipe would add little to the prevention of corrosion fatigue failures. The coating on the outside of the pipe would be polished off in a fairly short time during drilling and, as corrosion fatigue failures did not start at the outside, little benefit would be gained by applying an outside coating. The possibility of "gumming up" the jaws of tools applied to the outside of the pipe was also considered. "Gummed up" gripping surfaces obviously would not hold pipe.

Dr. L. E. Trishman, the author, in his office with test pieces of pipe.



To choose a satisfactory coating for the inside of the pipe, several factors had to be considered.

1. The coating must be impervious to water. A coating, no matter how resistant to chemicals, if it could not be applied free of pin holes, porosity, or fine cracks, would not prevent surface pitting.

2. Oil resistance is required.

3. Resistance to mild chemical attack is necessary. Some drilling muds are alkaline. Others become acid from sulphides picked up in drilling.

4. The coating should not soften or deteriorate up to 300-350° F. Bottonhole temperatures become quite high in some deep wells.

5. Resistance to mild abrasion is necessary.

6. The coating must not be brittle. A brittle coating might flake off or crack when bent pipe is straightened.

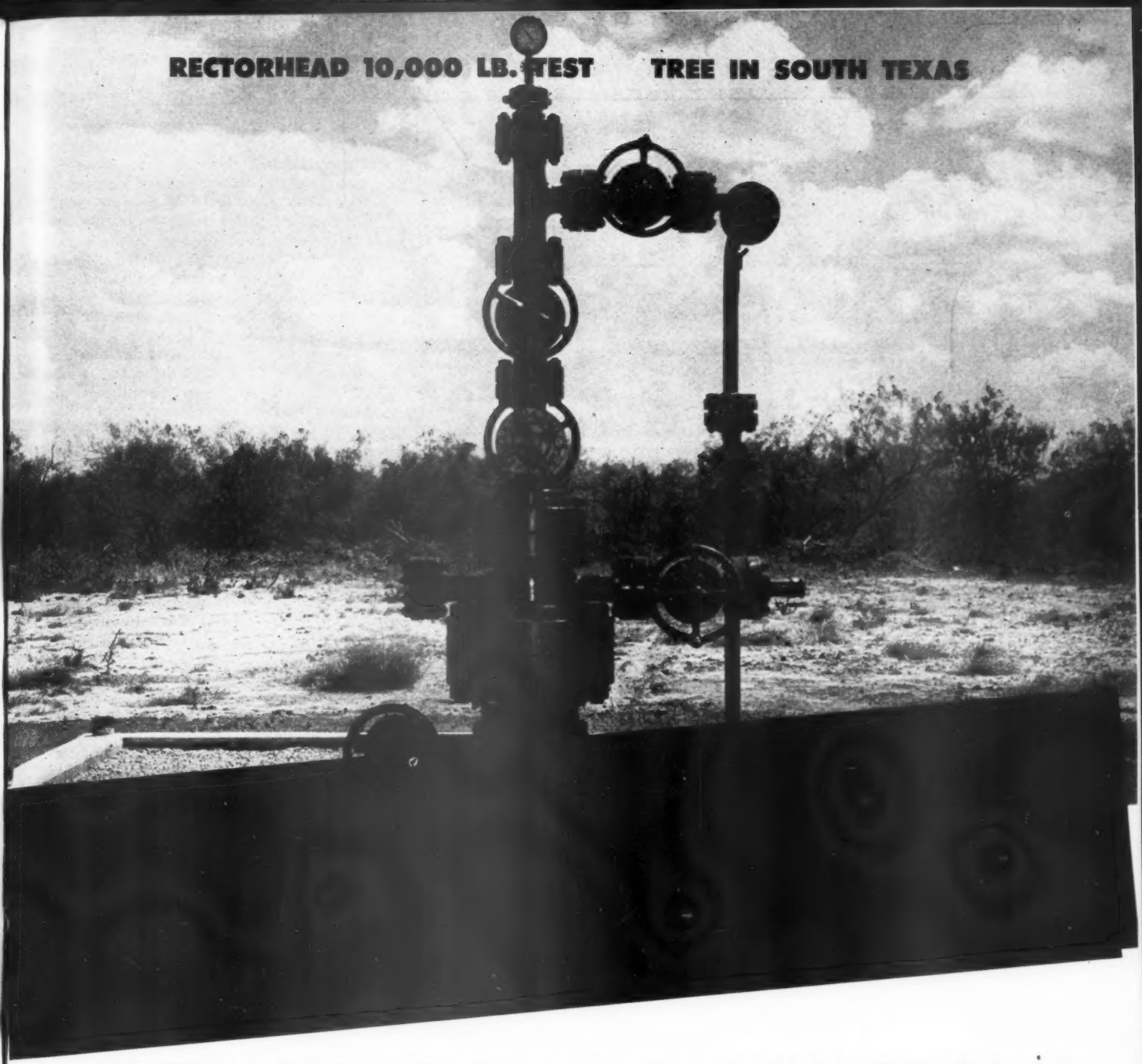
7. The coating material must have chemical stability. It must not oxidize in contact with the air or deteriorate to such an extent that it would become chalky or flake.

8. It must adhere well to the surface of the pipe.

9. It must not change the physical properties of the surface of the pipe.

10. The coating must be easy to apply inside the pipe. Satisfactory coating materials have been found that could not be applied inside pipe in lengths as long as drill pipe.

The properties of many coating materials were examined before suitable ones were found that could be tested under corrosion fatigue conditions. Metallic coatings were discarded because they could not meet requirement 9. Electro-deposited coatings would not meet requirement 1. Many non-metallic coatings, such as those with an asphaltic base, would not pass requirements 2 and 4. Some plastics failed to pass 4 and 6.



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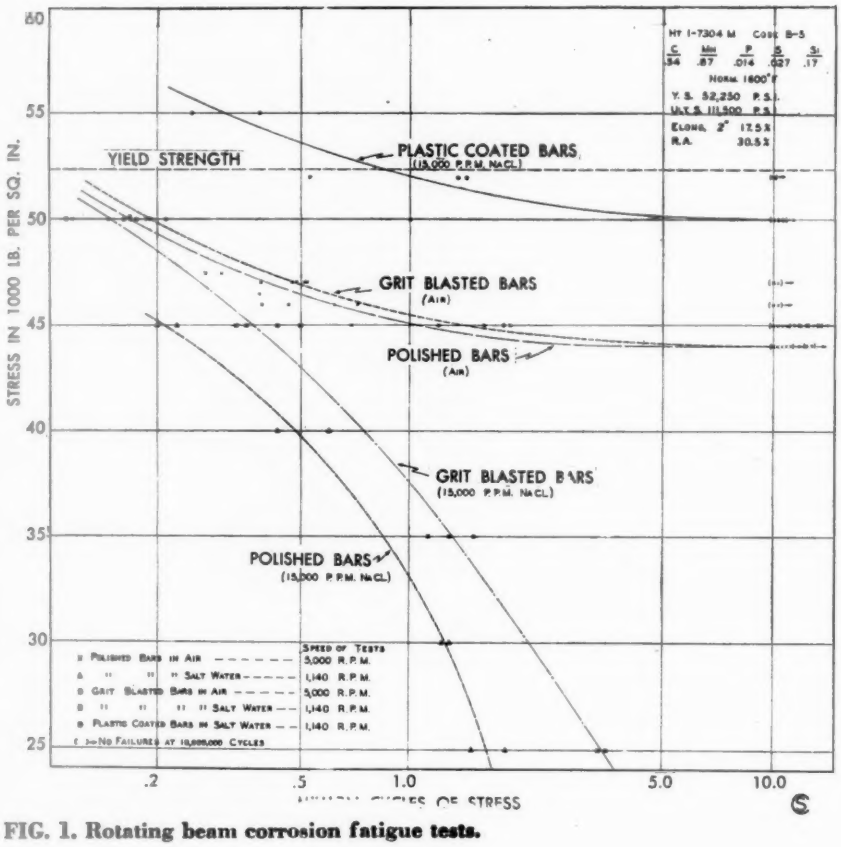


FIG. 1. Rotating beam corrosion fatigue tests.

Synthetic rubber coatings could not meet requirement 10. Although satisfactory in other respects they could not be applied satisfactorily inside long lengths of pipe.

From a long list of coating materials, two were found that gave satisfactory results in laboratory corrosion fatigue tests. One was an air drying phenolic plastic coating and the other a baking type (thermo-setting), phenolic base, plastic coating. These gave such outstanding results that it was decided to try them in experimental strings of pipe in field tests.

In 1942, two experimental strings of pipe were coated inside with air drying plastic. The experimental strings, for the most part, consisted of alternate lengths of coated pipe, scale-free pipe uncoated, and uncoated pipe as mill processed with the mill scale remaining in the pipe. The scale from the coated pipe, and the uncoated scale-free pipe, was removed by grit blasting.

A close check was made on the operation of these two experimental strings by our field engineers and samples were shipped to the research laboratory for examination from time to time. Out of 21 corrosion fatigue failures, only one was in a coated length of pipe and this length had become bent when a portion of the string had been dropped in the hole. All other failures were in the uncoated pipe that had not been cleaned of mill scale. The uncoated samples, which were in the cleaned condition only, became pitted and corrosion fatigue cracks began to develop in the pits. None had developed to the point of failure at the time the tests were concluded, however. The coating on the coated lengths of pipe did not stand up so well as expected. It had been removed in large patches, possibly by the abrasive action of the mud, and possibly by some corrosive action, because the pipe surface was found to be pitted and corroded. Up to this time, 25,000 ft. of hole had been drilled in "corrosive" or "hot spot" areas. Obviously the coating, and even the grit blasting of the inner surface alone, had improved the drilling life of pipe considerably.

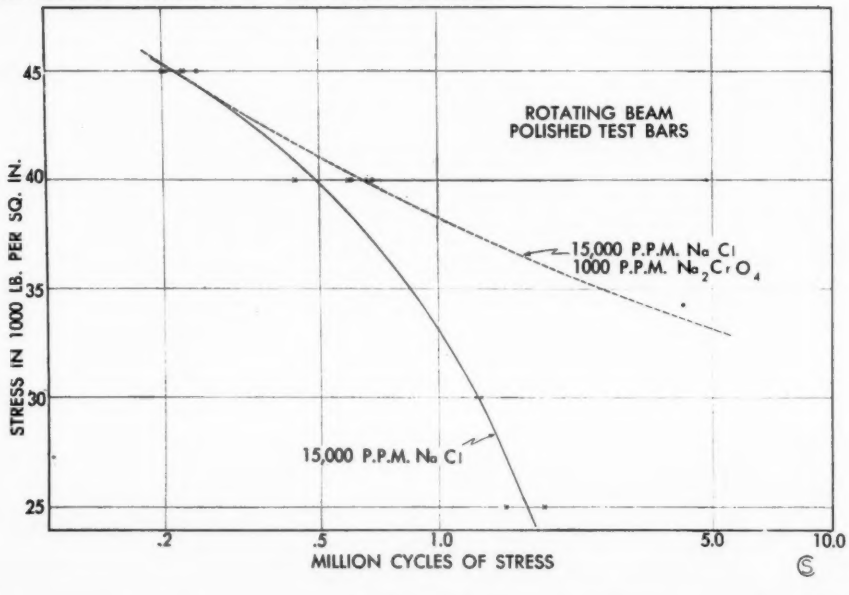
At this time, grit blasting the scale from the inner surface was recommended as a means of retarding corrosion fatigue failures. The coating, however, could not be recommended because it was thought not to be so good as could be expected. After this experiment, several strings were shipped in the scale-free condition only (grit blasted). These did show progress toward combating corrosion fatigue failures.

Nothing was published about the advantages of the air drying plastic because it was felt that a better coating could be offered. Consequently, work progressed in an experimental way, although retarded considerably by war experimental work, toward developing a method of coating the inside of drill pipe with a thermo-setting plastic.

Many laboratory corrosion fatigue tests were made using a rotating-beam fatigue machine. Some tests were made using aerated salt water of 15,000 parts per million as the corrosive. Others were made using the same salt solution to which sodium chromate was added as an inhibitor. Test bars coated with thermo-setting phenolic plastic also were tested. The fatigue curves obtained from these tests are shown in Figs. 1 and 2. Fig. 3 is a photograph of the fatigue machine used to make these tests. A low speed motor of 1140 r.p.m. was mounted directly behind the high speed motor of 5000 r.p.m. so that the corrosion fatigue tests could be made at a comparatively low speed. Tests made in air were driven with the high speed motor so as to complete the tests in a reasonably short time. The corrosive salt solution, contained in the bottle under the machine, was pumped and sprayed over the rotating test bar in the box-like corrosion cell, by a motor-operated aspirator bulb. The system was arranged so that no metal except the test bar came in contact with the corrosive salt solution.

An explanation of the curves of Fig. 1 may be in order. The curves for the

FIG. 2. Corrosion fatigue tests. Inhibitive effect of sodium chromate on salt water corrosion.



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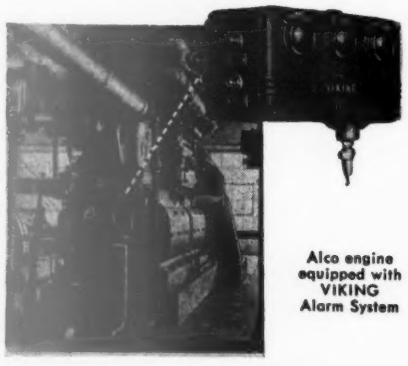

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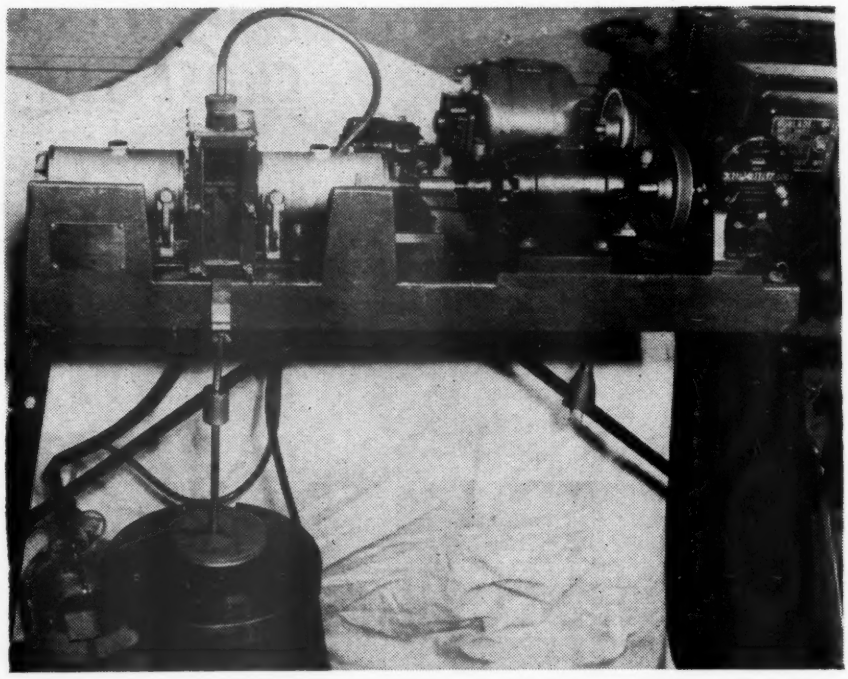

FIG. 3. The corrosion fatigue testing equipment used to determine the effectiveness of the plastic coating applied to drill pipe.

uncoated bars tested in air show that the bars break under rapidly reversed bending stresses at only about 100,000 to 200,000 reversals at an applied stress of 50,000 lb. per sq. in. At 46,000 lb. per sq. in., the bars will run to about a half million reversals, but at or below 44,000 lb. per sq. in. the bars will not break at 10,000,000 reversals. Engineers consider that a test that runs for 10,000,000 or more reversals will run almost indefinitely without breaking. The stress at which this takes place is called the endurance limit of that steel. It is the place where the Stress-Number of Cycles curve flattens out and becomes, for all practical purposes, horizontal. Note how the S-N curves turn downward under corrosive conditions when salt water is pumped over the test bars during the fatigue test. (The two lower curves of Fig. 1.) The curves show that under corrosive conditions an endurance limit cannot ever be reached.

Interpreting these tests to the operation of drill pipe, they mean that without corrosion, if such a condition could be obtained, a string of drill pipe could be used without fatigue failure until it wore out if the stress in the pipe were kept below the endurance limit. If corrosive mud comes into contact with the pipe, however, corrosion fatigue failure may occur in as few as one to five million revolutions in the hole. This figure will be the higher the lower the stress applied to the pipe. This brings out the reason why a driller should have weight on the bit by application of a large number of drill collars and not by letting the pipe "rest" on the bit; for as soon as he lets the weight of the pipe add weight to the bit, he is subjecting a certain length of his pipe to end loading, which makes the pipe bend and flex, putting heavy bending stresses on the pipe wall. The higher these bending stresses, the sooner the pipe will fail by corrosion fatigue. The two lowest curves on the chart show this very plainly.

When sodium chromate was added to the salt water in the laboratory tests, the lower curve of Fig. 1 shifted upward and to the right showing that the inhibitive action of the chromate retarded the corrosion to some extent. Fig. 2 shows the new curves. Note that the curves still slope downward. In other words, there is still no endurance limit. Drill pipe run with sodium chromate in the mud will last longer than drill pipe run without the inhibitor in the mud but the corrosive action has not been completely overcome.

Coating the steel with some inert material so that the corrosive substance cannot come into contact with it appears to be the solution of the problem. The top full line curve Fig. 1 shows the results of fatigue tests of sample bars grit blasted and coated with a thermo-setting phenolic base plastic tested under highly corrosive conditions. The curve has not only flattened out, giving again an endurance limit, but it indicates that the endurance limit has been raised from 44,000 lb. per sq. in. to 50,000 lb. per sq. in.

The test bars for all the tests were made from the same material and all prepared in exactly the same way except for the variation noted on the chart. Various explanations have been offered for the improvement of the endurance limit of the coated bars over the uncoated bars tested in air. Possibly the heat of baking the coating has produced an age-hardened envelope around the test bar

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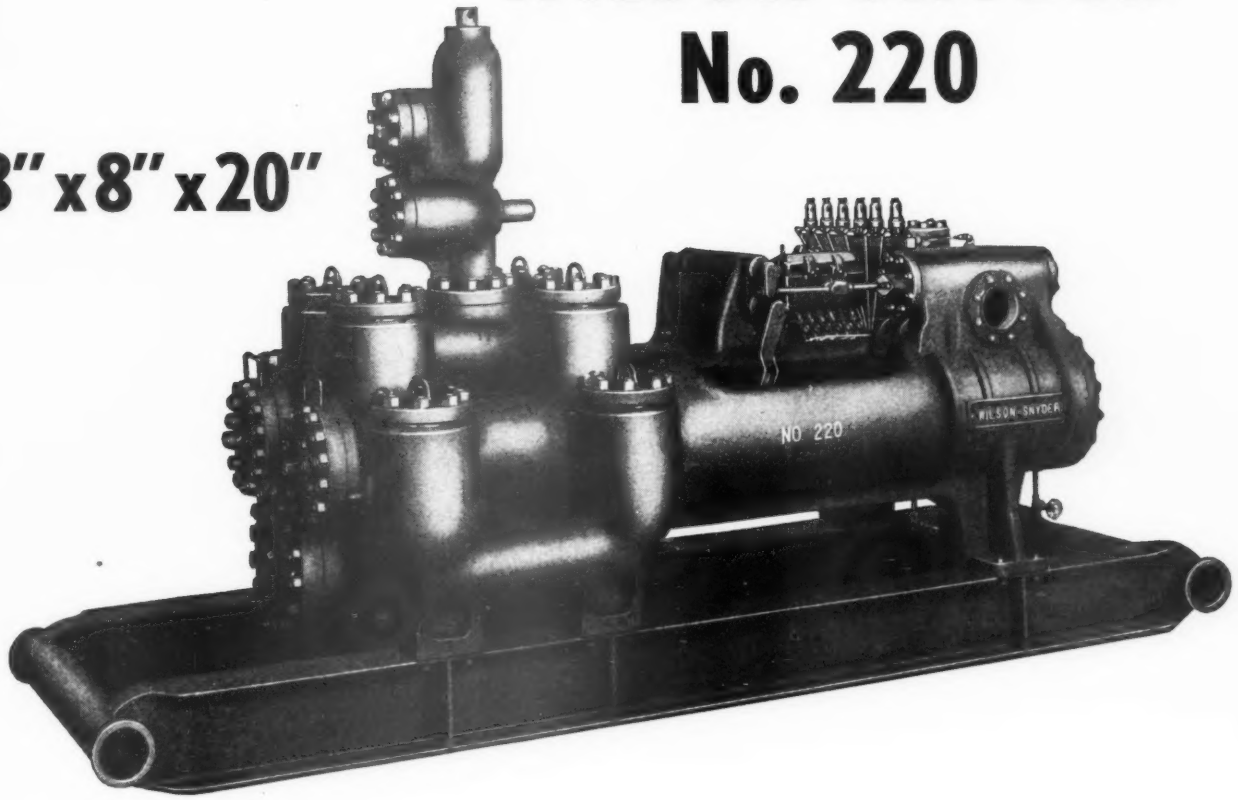

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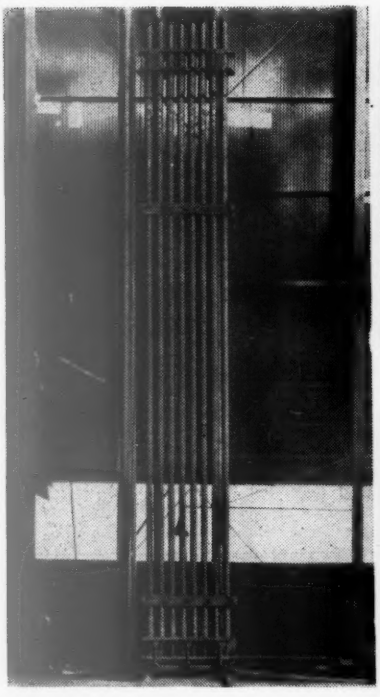

FIG. 4. Equipment for applying plastic coating to inside of pipe only.

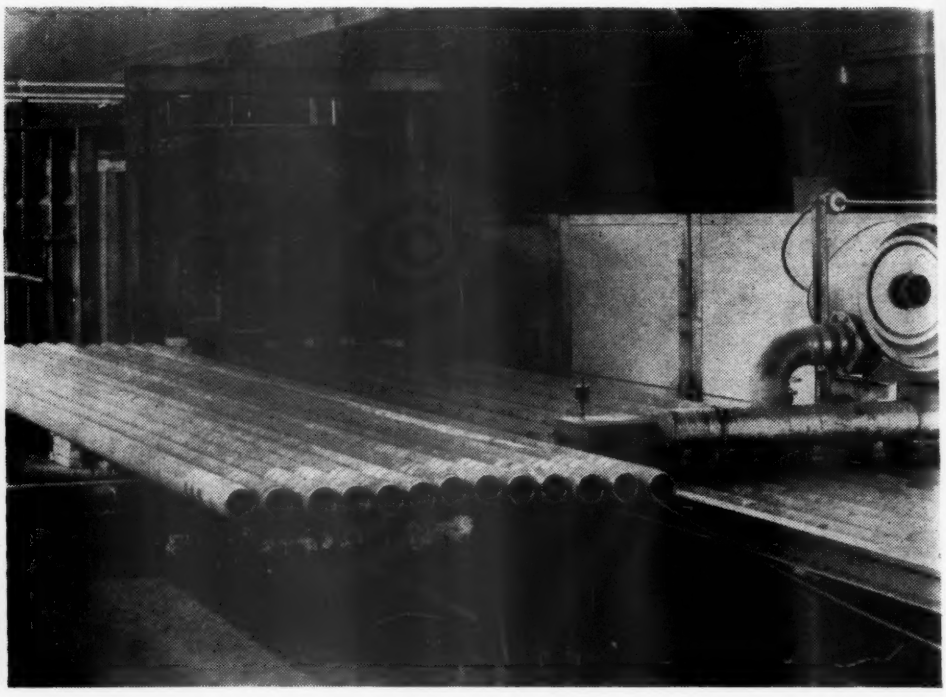

FIG. 5. Pusher type furnace for baking the plastic coating to the surface of the pipe.

within the grit-blasted layer. Perhaps the industrial atmosphere, in which the tests in air were made, was slightly corrosive causing a drop in these values. The coating material is not stronger than the steel, therefore, it could not possibly strengthen it.

Fatigue tests on non-ferrous metals made in a non-corrosive atmosphere composed of pure nitrogen have been reported in the literature, which gave values higher than comparable tests made in air. This supports the argument that air is slightly corrosive toward the test bars.

Regardless of the question of increased physical values, the coating has eliminated the effect of corrosion and brought about the return of the endurance limit. A driller, then, could operate coated pipe without the fear of corrosion fatigue failures from the inside so long as the coating remains intact.

Because of the excellent results obtained from the laboratory tests of coated fatigue test bars, it was decided to coat the inside of four strings of pipe for field tests. The coating material applied has been found to be oil-resistant, chemically inert except to hot concentrated alkali, resistant to heat up to 400°F., abrasion-resistant, and chip-resistant. It has been found to be resistant to cold alkali in solutions of 0.3 normal (1.2 per cent), which is a fairly strong solution.

Fig. 4 is a photograph of drill pipe in the coating equipment. Here several lengths of grit blasted pipe are stood on end over a suitable manifold. The liquid plastic coating material is pumped to the top of each length of pipe and then permitted to drain out at an accurately controlled predetermined rate so as to give a continuous coating free of runs, bubbles, pin holes, or other defects. Four coats are applied in this manner. Between each coat the pipe is taken down and pushed through a baking furnace shown in Fig. 5. Here the coating is baked to the desirable degree of flexibility and maximum chemical resistance. The baking process also bonds the plastic thoroughly to the surface of the pipe.

The four strings coated in this way were shipped to drilling companies A, B, C, and D, in the latter part of 1945 for field trial. As before, for comparison in the field tests, the coated lengths of pipe were alternated with uncoated lengths carrying mill scale on the inner surface.

Of the four strings, A has seen the most service. At the last report, it had drilled 29,000 ft. of hole with 14 failures, 11 in uncoated pipe and three in coated. All drilling was done in corrosive areas. Samples from the failed lengths of pipe were examined by the research laboratory. None of the coated lengths had failed by corrosion fatigue and the coating was still intact and in good condition. From each sample the coating was stripped off with hot alkali. The steel underneath was found to be free of corrosion fatigue cracks and pits. It was as smooth as before it was coated. The coated pieces that failed were found to have failed by pure fatigue from the outside of the pipe wall inward. This is believed to be true because no pits or transverse scores were found at the regions where the fractures started.

Up to now, the B string has drilled 24,000 ft. of hole. Three corrosion fatigue failures have developed in the uncoated pipe and no failures have been reported in the coated pipe. This string has been in use in the corrosive areas also.

The C string has not yet been put to use.

The D string has drilled 9181 ft. No failures have been reported to date.

In addition to the protective value of the coating itself, all coated samples that were returned from the field also carried a calcareous deposit, which developed during drilling, on top of the coating. This deposit should give added protection. Just why this deposit forms on top of the coating and not on the uncoated pipe we have not yet been able to determine.

Of the protective methods applied against corrosion fatigue failures in drill pipe, the following conclusions can be drawn at this time.

1. The inhibitive effect of sodium chromate in the drilling mud, if the concentration is kept up, appears to be beneficial, although the field tests are inconclusive at this time.

2. Laboratory corrosion fatigue tests show that sodium chromate is beneficial in retarding corrosion fatigue failure but the S-N curves show that an endurance limit is not obtainable.

3. Field trials of drill pipe coated on the inside with a thermo-setting plastic have shown excellent resistance to corrosion fatigue failure. Although the tests of the four separate strings will probably not be completed for several months, the tests show that protecting the surface of the pipe with a suitable coating will stop corrosion fatigue failures.

4. Laboratory tests of fatigue test bars coated with a thermo-setting plastic have given surprisingly good results. A definite endurance limit is obtainable with coated test bars under corrosive conditions.

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Refrigeration and horsepower

By W. F. SCHAPHORST

IN THE January, 1946, issue of *The Petroleum Engineer*, page 222, a short article and chart by this writer appeared under the above title.

EXCLUSIVE

A constructive criticism has been received pertaining to that article from J. B. Taylor of the Signal Oil and Gas Company of Long Beach, California, as follows:

"With reference to the chart on 'Refrigeration,' I am glad to offer this suggestion:

"Refrigeration may be accomplished by the transfer of heat, (1) from a warmer body to a colder one, (2) by absorption of heat when expanding a compressed gas, (3) by evaporating liquids that have a low boiling point.

"As your article states, the transfer of 200 B.t.u. per min. or 288,000 B.t.u. per ton of refrigeration represents the required rate of heat transfer. However, in any of the above methods of accomplishing refrigeration a large portion of the heat is transferred through condensers of different types and heat exchange equipment rather than through mechanical horsepower as indicated by your chart.

"For instance, the conventional ammonia or propane refrigeration plant operates on the following cycle: Compression, condensation, expansion, and evaporation of the refrigerant. The only mechanical horsepower requirements are during the compression part of the cycle. The amount of horsepower so required may easily be determined by the use of a Mollier chart on the refrigerant being used, or determining the enthalpy of the gas at suction conditions and the enthalpy at discharge pressure under constant entropy conditions. Thus, it may be seen that the actual horsepower requirements will vary according to the pressure-temperature conditions, but in any event will not approach the total heat of refrigeration due to the large extraction of heat in the condensation of the refrigerant material.

"Illustration: Using propane as refrigerant:

Suction conditions, 5°F., 42 lb. abs.	=279 B.t.u. per pound
Discharge conditions, (constant entropy) 155 lb. abs.	=305.5 B.t.u. per pound
Work of compression	= 26.5 B.t.u. per pound
Saturated vapor, 5°F., 42 lb. abs.	=279 B.t.u. per pound
Saturated liquid, 86°F., 155 lb. abs.	=157.6 B.t.u. per pound
Net refrigeration available	121.4 B.t.u. per pound
One ton of refrigeration	=200 B.t.u. per min.

200 B.t.u. per min $\left(\frac{200}{121.4}\right)$ = 1.647 lb.

*Horsepower per ton is $\frac{26.5 \times 1.647 \times 60}{2545}$ = 1.03

*This value will vary with actual conditions of operation

"The objection to relating the total heat of refrigeration to mechanical horsepower is considered by the writer as not representing true conditions that are normally found to exist. The experience of the writer with refrigeration in natural gasoline plants is that it is a most economical means of increasing plant capacity or improving absorption conditions, and merits further consideration. The reflection of large horsepower requirements may deter some operator from considering its use."

What Mr. Taylor says is doubtless correct and the writer is happy to acknowledge the fact that the theoretical equivalents as given in the original chart *are* greater, in most instances, than the actual power required to produce the results wanted, all of which makes it appear that refrigeration is "pretty much of a bargain," and it usually is. Some people consider refrigeration as being expensive. Some people consider it inefficient. But refrigeration is neither expensive nor inefficient, as a general rule, as indicated by Mr. Taylor who points out that, as a matter of fact, you can be fairly sure that you will get considerably *more* than the theoretical values from whatever refrigeration apparatus you may install. Why is this? Because, in refrigeration, so much depends on the temperature of the cooling water, the cooling air, or whatever medium is used for cooling. Thus some refrigerating engineers figure roughly that it takes about 1 hp. per ton of refrigeration, which is about five times as much as the refrigeration equivalent shown by the theoretical chart. In other words, if you have a compressor that delivers 10 tons of refrigeration a 10-hp. motor will do the work whereas the theoretical chart says you will need a 48-hp. motor.

As expressed by one engineer, "There is no practical direct relationship between horsepower and refrigeration on a B.t.u. basis. In a refrigerating plant the cooling water or air does all the work, and the power just pushes the refrigerants around. Examined on a purely B.t.u. basis the ice plant operates at more than 400 per cent efficiency. Of course, this is silly."

Nevertheless the writer considers this of sufficient importance to be brought out more emphatically than has been the case up to the present time. Refrigeration *is* a bargain in most of the United States because the temperature of the water used for cooling is fairly low. At the North Pole, for instance, one could very likely produce 100 tons or more of refrigeration with a 1-hp. motor. At the equator, on the other hand, results would approach the theoretical values of the chart if the cooling water is warm—and the writer understands that in the tropics most cooling water *is* warm. In the United States the coolest water during the summer weather is said to be at Lowell, Massachusetts. Therefore, refrigeration would be the greatest "bargain" in that city. On the other hand, as may be surmised, the warmest water is in the south. The warmer the cooling medium, the less the bargain. That is why the writer likes to have the theoretical chart before him—for purposes of comparison.

★★★

CHART

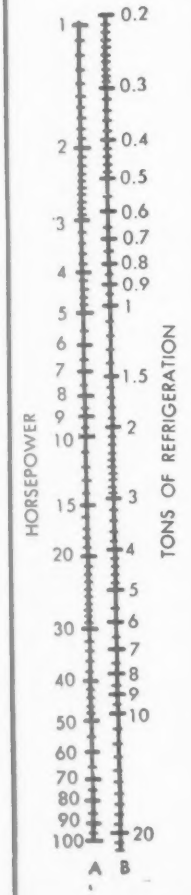

Chart is based on theoretical values. A ton of ice represents 288,000 B.t.u. And since one B.t.u. is equal to 778 ft.-lb., and there are 33,000 ft.-lb. in a horsepower per minute, it is evident that the theoretical relationship can be readily determined. The chart shows that one horsepower is equivalent to 0.21 ton of refrigeration, or, 10 horsepower is equivalent to 2.1 tons. In other words, with an overall refrigerating machine efficiency of 100 per cent a 10-hp. motor would produce 2.1 tons of ice in 24 hr. A 100-hp. motor would produce 21 tons of ice in 24 hr.

For example if you should want to know the theoretical equivalent of 6 tons of refrigeration, you use the chart in this way: Find the 6 in column B and glance across to column A. The answer is 29 hp.

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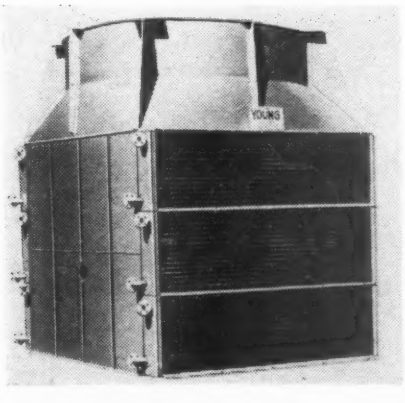
(1) *Young radiators*

A series of new type large capacity cooling and condensing radiators designed as VAD units has been announced by the Young Radiator Company, Racine, Wisconsin.

The series ranges from the VAD-10 (illustrated) to the larger VAD-16 with capacities for the water cooling unit ranging upward from 3,600,000 B.t.u. per hr. at standard conditions. The cooling faces are placed on two opposite sides of the unit to permit line installation of several units where very large capacities are required, with no loss in efficiency or cooling faces blanketed off. Testimony for the versatility of the VAD design is brought out by their availability for water cooling, oil cooling, steam and vapor condensing, gas cooling, or in combination arrangements to handle two or more types of service.

Following are some of the distinctive design developments incorporated into the VAD units: Vertical air discharge with an induced-draft fan to obtain more even air distribution and eliminate recirculation and cross wind effects; low speed fan for high efficiency operation with minimum horsepower costs; coils mounted in a vertical plane for economical installation, easy maintenance and maximum protection from the elements, (snow, hailstorm, etc.); simplified manifolding to supply and return lines; tube and fin coils with heavy wall round tubes for long and reliable service—removable end plates on water coils for quick and easy access to tube headers for inspection and cleaning; fan and drive assembly mounted independent of main unit assembly, thereby eliminating the transmission of any vibrations from moving to non-moving parts; low level mounting and simplified foundation design for utmost accessibility to all components.



The VAD units embody advancements in large unit design that are the culmination of more than 25 years' experience in the design and manufacture of heat transfer equipment. Young also manufactures a line of standardized engine jacket water coolers, automotive and aviation radiators, and oil coolers, heat exchangers, and a complete line of heating, cooling, and air-conditioning products.

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(2) *Emulsifying agent*

Marketed under the trade name of Mulsirex, a new emulsifying agent designed for use with kerosine and other petroleum cleaning agents to insure greater safety, efficiency, and economy has been introduced by Turco Products, Inc., of Los Angeles.

Mulsirex is recommonded for removing very heavy deposits of oil and light grease from all kinds of metal parts and equipment. In solution with petroleum cleaning agents, Mulsirex adds to the cleaning potency of these agents through its deep penetrating qualities and, at the same time, because of its remarkably high flash point (180°F.), greatly increases the margin of safety for the operator, it is stated. The emulsifying characteristics of this product make foreign substances readily soluble in water, a feature that permits the deposits to be flushed away after application of the cleaning agent with a simple cold water rinse.

Because it can be used in dilutions as high as 1 to 10 with solvents, the manufacturer points out that Mulsirex is remarkably economical to use. Easily and quickly applied with a spray, brush or mop, or as a cold tank immersion solution, it is perfectly harmless to metals and enameled surfaces.

(3) *Oil, gasoline hose*

Lighter weight, increased flexibility, and greater softness are achieved in a new oil and gasoline hose developed by United States Rubber Company for use in unloading oil trucks and tank cars.

The carcass consists of two plies of Ustex, a chemically treated textile 70 per cent stronger than conventional cotton yarn. Three plies of cotton were formerly required. The hose is lined with a synthetic rubber compound, which resists aromatics and high octane fuels.

Because of reduced outside diameter, standard size couplings may be used on the new hose, whereas oversize couplings were required on the three-ply construction, it is stated.

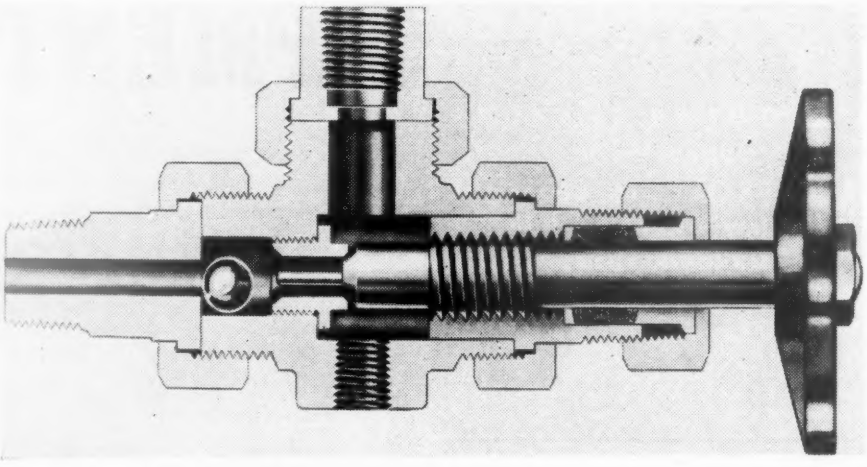
(4) *Cardwell "third" drum*

A new Cardwell "third" drum for the Cardwell Model "R" cable tool drilling rig provides a total of three separate, independently driven drums for drilling line, casing line, and sand line. Three drums eliminate the necessity of unspooling one line to spool on another when changing operations. The "third" drum is especially useful with beam operation when the driller finds it necessary to "carry the pipe," it is pointed out.

The "third" drum is driven from the rotary drive friction clutch on a countershaft and through an 8-jaw dentil type clutch mounted on the drum end. Spudder or beam operation is not interfered with in any way. The equipment is available with a new machine or can be applied to any Cardwell Model "R" spudder or beam rig in the field.

(5) *Jerguson gage valve*

Jerguson Gage and Valve Company, Somerville, Massachusetts, announces a new type of gage valve (No. 64) with union connection to both the gage and the vessel. This makes it possible to remove the gage for inspection or maintenance without disconnecting the valves. Such a valve is useful on installations where it would not be practicable to shut down operations for removing the gage, the manufacturer states. The two valves are merely closed and the union connection to the gage unscrewed. The gage then can be removed. Operations in the meanwhile continue without interruption.



(6) *Displacement pump*

The Sier-Bath Gear and Pump Company has introduced the Gearex Rotary Pump. This pump is of the positive displacement type and comes in internal-bearing models for lubricating fluids and external-bearing models for non-lubricating fluids. It is a medium duty pump available in capacities from 1 to 550 gal. per min. Discharge pressures up to 250 lb. per sq. in. can be maintained with liquids, such as water and solvents.

Feaures of these pumps, according to the manufacturer, are high efficiency, low maintenance, vibrationless operation, and pulseless discharge. Rotors of the continuous herringbone type and discharge passages of the proper area insure continuous overlapping displacement of the liquid. The noncontacting rotors are deep toothed and small in diameter to provide low pitch line speeds even at high r.p.m., resulting in quiet and efficient operation. Direct connection by flexible coupling eliminates the need of reduction gears or belts between pump and driver.

Extra deep stuffingboxes are standard equipment. Special alloy materials or jacketed bodies for special services may be supplied to specification. Either vertical or horizontal mounting may be specified.

(7) *Electron diffraction*

Production of 15 more electron diffraction instruments, first commercially available unit of a type now being used to make practical a study of quartz crystals and metal surfaces in the oil, steel, roller-bearing, chemical and other industries, has been announced by the General Electric Company.

After successful operation of the instrument at universities and industrial concerns for the past year, the specialty division of the Electronics Department said it would manufacture the units at its Syracuse, New York, Welf street plant.

The Electron Diffraction instrument is a desk-like unit that fulfills a need for a device to study surfaces. Conventional x-ray and electron microscopic equipment penetrate substances but provide little information on surfaces.

The G. E. instrument is now used in laboratories of ten universities and industrial concerns throughout the nation. It was developed in the company's research laboratories at Schenectady and stems from apparatus first designed to establish the wave nature of electrons. Scientists and engineers define the unit as an aid to a technical or detailed "submicroscopic" study of surfaces or as equipment that solves the research problem of defining the photoelectric work function of various alloys.

Capable of examining specimens weighing as much as 40 lb., all the work of the instrument is done in a vacuum with the aid of electrostatic and magnetic fields.

Here is an explanation how the Electron Diffraction Instrument works. An electron "gun" is housed in a chamber atop an ordinary-sized desk. This gun "shoots" electrons at the specimen in a high-vacuum compartment. Before hitting the specimen, however, the "electrons" pass through an electrostatic field of 40,000 volts, which accelerates them, and a magnetic field that focuses them. After hitting the "target," the electrons "bounce" and form a diffraction pattern on a photographic plate. The "target" may be turned in any direction for a complete study of all sides or angles.

(8) *Adjustable weighbeam*

Republic pneumatic pressure and differential pressure transmitters can now be supplied with an adjustable weighbeam—a new development that makes possible a 15 to 1 range change without change of parts. The only readjustment necessary is rebalancing for zero.

This feature is provided by replacing the standard weighbeam by a double weighbeam having an adjustable pivot between the two halves. The range of the transmitter is changed by merely sliding the adjustable pivot along a calibrated scale to the desired setting. For example, a differential transmitter having a minimum range of from 0 to 1.0 in. of water can be changed to any range up to 0 to 15.0 in. Similarly, a transmitter with a minimum range of 0 to 8.0 in. can be changed to any range up to 0 to 120.0 in.

The flexibility of application provided by this new development is of paramount importance on those installations where operating conditions are highly variable or on new installations where flow or pressure conditions are unknown, it is pointed out.

The manufacturer is the Republic Flow Meters Company, Chicago, Illinois.

(9) *Safety valve*

A safety valve of unusual design, which is actuated by the velocity of line fluids on its cone-shaped valve stem, was offered to the oil industry recently by Oilfield Machine and Supply Company, Houston, Texas.

It is designed to provide a surface-installed, simple and inexpensive means of shutting in wells. flowlines, or pipe lines in the event a break occurs in the flow system.

Fire hazards, damage to crops and buildings in the vicinity, contamination of nearby streams, and production losses due to line breaks have been eliminated with this new Omsco safety valve, it is stated.

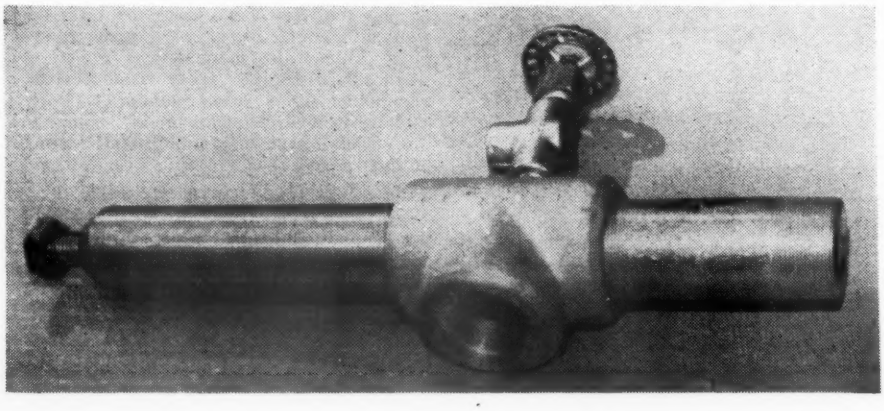
The Omsco safety valve is actuated by the "drag" of fluids—gas or oil—on its cone shaped valve stem. The valve is set, by means of one screw adjustment, to pass fluids at a certain desired velocity. If the pressure drop across the valve increases, as would happen in event of a line break downstream from the valve, the increase in rate of flow or increased velocity past the cone valve stem will pull the stem into the seat, thereby shutting in the well.

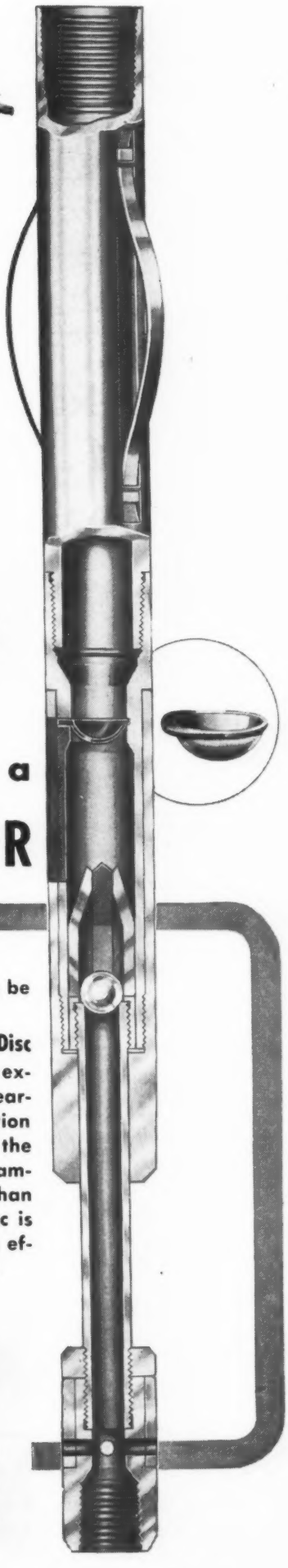
Sensitivity of the valve is adjustable. It can be made to close if the pressure drop across the valve exceeds the desired value by as little as 2 or 3 lb. or as high as the operator desires.

Reopening the safety valve must be done manually to insure that flow will not start again until desired.

The Omsco safety valve has only one moving part. There are no pistons to stick or become fouled with sand or scale. It can be installed in any position.

Construction is of either stainless or quality steel. All internal parts of alloy steel models are cadmium plated. The safety valves are available in a variety of sizes.





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Exclusive Grant Composition Sealing Disc

The Composition Sealing Disc, an exclusive Grant feature, eliminates wearing parts in the Bailer. This construction allows nearly the entire length of the bailer to function as a loading chamber, giving it a greater capacity than any other on the market. The Disc is broken on each run and serves, in effect, as a new valve for each run.

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BRANCHES—Avenal, Bakersfield, Santa Maria, Venture, California • Houston, Odessa, Texas.

(10) *Electrofluid drive*

Link-Belt Company announces the development of a new type of "packaged" power unit, to be known as Ling-Belt Electrofluid Drive. It is presently available in horsepowers up to 20. The Electrofluid Drive is a neat, compact, motorized hydraulic combination consisting of a general-purpose a-c. induction motor flange-mounted on a sturdy housing containing a hydraulic coupling, also called "fluid coupling." Its output shaft may be direct-connected to the driven machine or to a speed reducer unit. It may also be connected to driven machine through the medium of chain, gear, or belt drives.

Each fluid coupling has a primary and a secondary element. The primary element may be likened to a centrifugal-pump impeller and the secondary, or output element, to a waterwheel or runner.

The coupling is filled with a light mineral oil of steam-turbine quality. When the motor drives the impeller, it causes oil to flow through the runner buckets back to the impeller, thereby rotating the runner through the medium of the oil.

The torgue of the motor is transmitted from impeller to runner by the fluid in the coupling. There is no mechanical connection between the two elements of the fluid coupling.

In effect, the fluid coupling inserted between the motor and its load serves as an automatic clutch, with the fluid acting as a "cushion" between prime mover and driven machine.

Without need of any complicated starting control or special type of motor, the Link-Belt Electrofluid Drive has ideally solved the problem of inadequate torque and excessive high starting current peaks, the manufacturer states.

Regardless of the characteristics or inertia of driven machine or connected load, the motor of the Link-Belt Electrifluid Drive starts at no-load, because at zero speed the torque transmitting capacity of the fluid coupling is zero.

The motor accelerates quickly, developing torque in the fluid coupling in the ratio of the square of the speed, until sufficient torque up to the maximum running torque of the motor is developed to start the driven load.

Should the driven machine become stalled, the Electrofiuid Drive will pull to the maximum torque capacity of the motor, thereby drawing sufficient current to cause the thermal overload protective device to function within a few seconds.

The fluid traction coupling absorbs the energy of the motor rotor, protecting the driven machine from the shock of the rotor's inertia under sudden stoppage.

The Electrofluid Drive delivers the maximum torque of which the motor is capable, to overcome a momentary demand that might otherwise shear a pin or stop the power source completely. This cushioning effect protects both the motor and the driven equipment.

Shock loads from the driven side are smoothed out and cannot reach the motor. Because the shock never strikes solid resistance, the gears, chains, belts, or speed reducers in the driven mechanism are protected against severe strains and impact.

Torsional vibration is effectively cushioned by the fluid coupling, so that a smooth power flow is obtained.

(11) *Baroid pipe wiper*

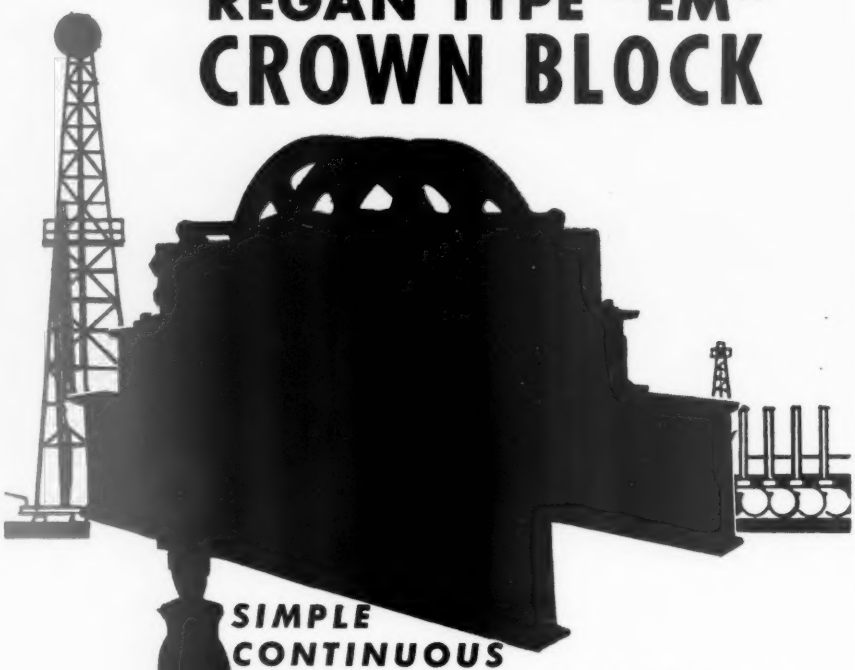
Baroid Sales Division, National Lead Company, announces a complete line of drill pipe wipers in new replaceable-insert and one-piece types. These wipers are said to have all the advantages of conventional wipers plus:

(1) Replaceable inserts. When wear or damage from tool joints or protectors makes the Baroid wiper ineffective, the operator need only replace the worn insert. This replacement makes the wiper good for many more thousands of feet of pipe at a fraction of the cost of a new wiper. One rim will outlast several inserts.

(2) Tapered center hole. Taper provides increased wiping efficiency and longer life because of more even distribution of pressure on wiping surface.

(3) Raised center hub. Extended hub gives increased wiping surface and does an effective wiping job.

REGAN TYPE "EM"
CROWN BLOCK



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OVER AND OVER REEVING

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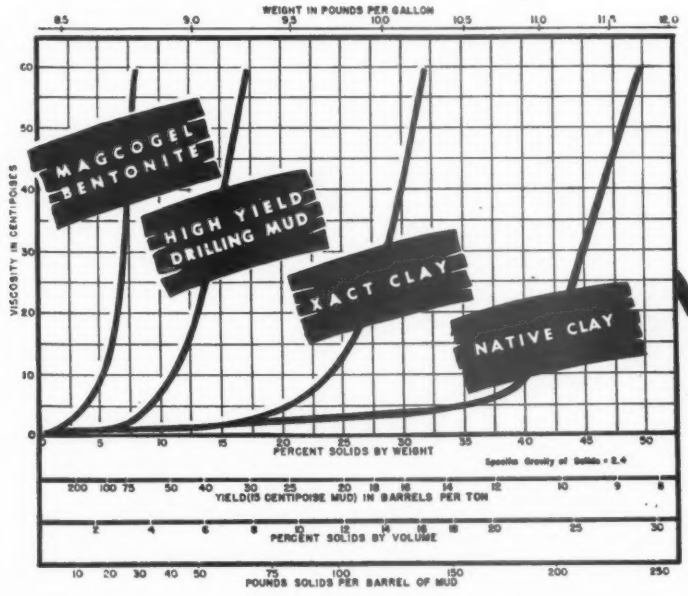

This chart provides a convenient method of comparing the characteristics of Magcogel Bentonite, High Yield Drilling Mud and Xact Clay with native clay.

MAGCOGEL BENTONITE. . . Made from the finest gel forming colloidal Wyoming bentonite. Careful control of processing assures uniformity of Magcogel Bentonite — mixed with water it yields approximately 100 barrels of 15 centipoise mud per ton.

HIGH YIELD DRILLING MUD. . . A ready-mixed mud in dry form that will yield approximately 50 barrels of 15 centipoise mud per ton when mixed with water. Easy to use. Most economical for building a balanced drilling mud.

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Baroid pipe wiper expanded to permit the passage of a protector on a string of drill pipe. Flexible design permits easy passage of protectors.

(4) Strong, flexible construction. Radial ribs strengthen wiper yet allow easy stretch to permit passage of joints and protectors. Uniformly blended rubber securely joined to steel reinforcing ring provides great elasticity and long wear.

The Baroid drill pipe wiper (Type RC) is available with replaceable inserts, which are said to extend wiper life several hundred per cent. The conventional one-piece Baroid wiper (Type S) embodies the same advantageous features as the Type RC with the exception of the replaceable insert.

By using the Baroid (Type RC) replaceable-insert wiper, operators do not have to discard worn or damaged wipers, but can either bolt or lace in a new insert, using whichever method they prefer. This easy operation requires no special tools and can be accomplished in a few minutes.

The replaceable-insert also eliminates the need of additional wipers for different sizes of drill pipe. One wiper rim with two inserts of the proper sizes will serve two sizes of drill pipe, thus effecting another substantial saving. If the drill collar, stabilizer, or bit damages the insert, only the insert need be replaced.

Both the replaceable-insert (RC) and one-piece (S) types of Baroid wiper are available in outer diameters of 14 in., 15 in., 17 in., and 19 in. Each of these sizes is manufactured for both 3½-in. and 4½-in. drill pipe.

(12) *Offset joints*

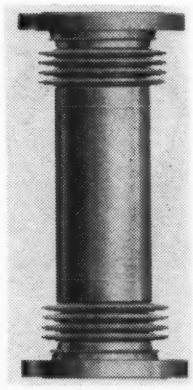
MagniLastic announces production of a standard line of offset joints, another in its series of packless expansion joint types suitable for all piping conditions.

This latest addition to the MagniLastic line provides a standard flexible unit for joining pipe terminals that are out of line—or offset. This condition may be due to accumulated excess tolerances in piping sections, to settling and shifting at anchor points or hangars, thermal expansion and contraction of pipes and mountings, or to variations in operating conditions.

Severe stresses and damage may result when makeshift measures are employed to bring misaligned pipe ends together, it is pointed out.

The MagniLastic offset joint is constructed with an equal number of expansion flanges on either end of an insert section. Length of unit and number of flanges are determined by misalignment condition to be corrected.

Offset joints are supplied with bellows flanges from any of the MagniLastic standard expansion joint series, which includes pressures from vacuum to 1000 lb. per sq. in., pipe sizes from ½ to 24 in., and temperatures from minus 300 to plus 1600°F. Joints of stainless steel, monel, inconel, and copper cover all common corrosive conditions. End fittings are available in welding end or Van Stone bolted flanges.

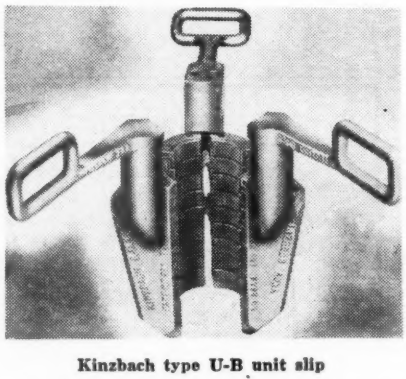


In addition to joining offset pipe terminals, MagniLastic offset joints protect valves, headers, and fittings from undue strain and tension, it is stated.

A catalog containing complete information on the offset joint, other MagniLastic expansion joints, and special units, is available. MagniLastic is a Division of Cook Electric Company, Chicago, Illinois.

(13) *Kinzbach equipment*

Recently introduced, Kinzbach Type U-B unit slips are designed to support safely the long strings of drill pipe being used in today's drilling. Four individual segments, connected by an unusual hinging arrangement, provide great flexibility and even distribution of pipe weight. Each segment aligns independently around the pipe and carries its proportionate amount of weight. The unique hinging provides practically true wedging action. Nine separate, broad-faced inserts in each segment provide for unconformities in pipe walls and insure true contact. Ample fluid drain-back is provided; broad cored backs eliminate cutting of master bushings, yet will not stick under the heaviest loads, it is stated. A new handle design keeps the operators' hands clear of the rotary table and elevators at all times and provides better balance for easier setting and picking up of the slips.

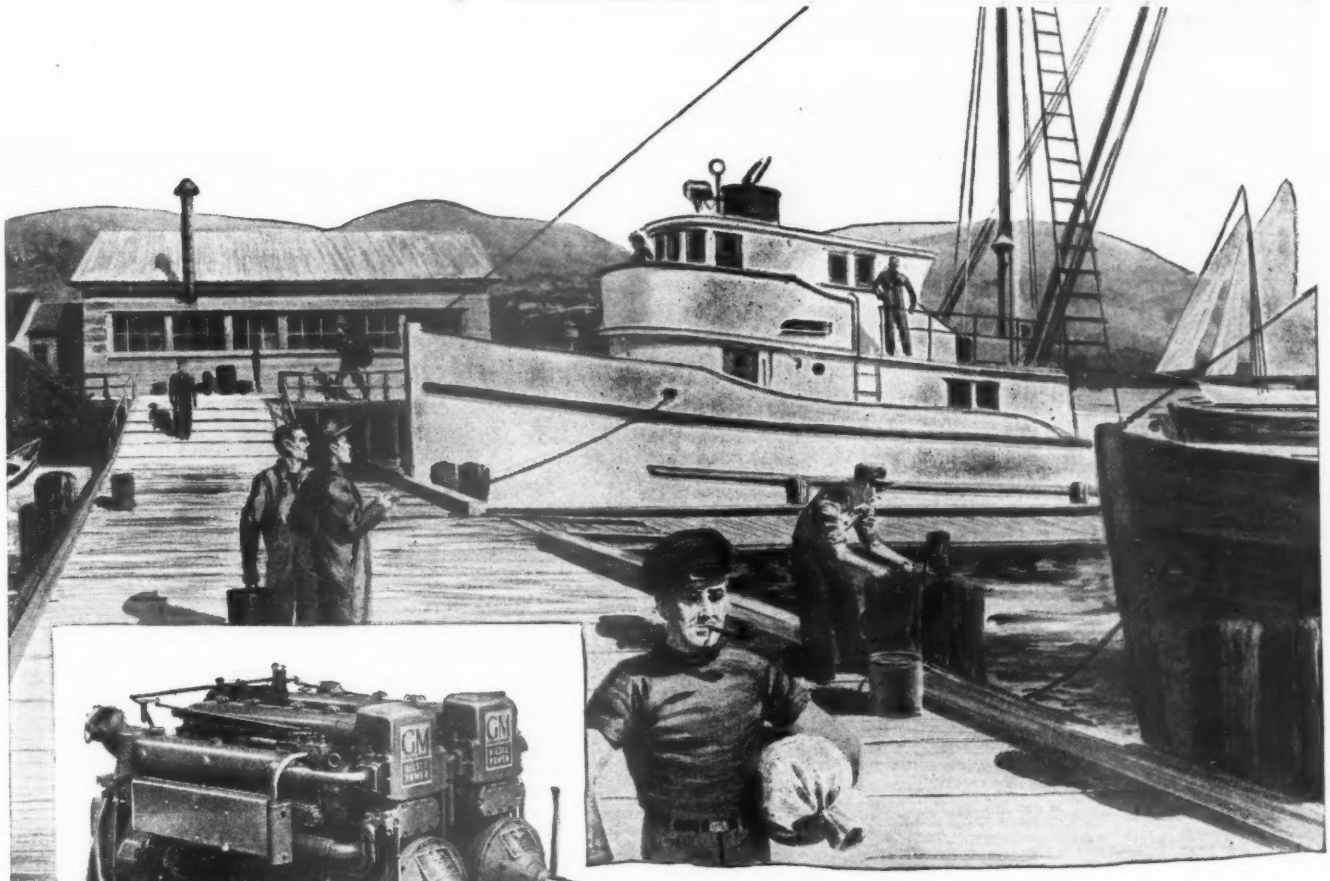


Kinzbach type U-B unit slip

One of the outstanding features is that, through interchangeable segment inserts, several sizes of pipe can be handled with one set of slips. Inserts are easily removed and replaced on the derrick floor.

Kinzbach Type U-B unit slips are made for all popular sizes of API drill pipe.

A floating gland by the same manufacturer provides true self-alignment in the new Kinzbach Type C polished rod stuffing-box. Self-lubricated plastic packing, devel-



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ECONOMICAL—run on low cost fuel

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QUICK ACCELERATION—2-cycle principle produces power with every downward piston stroke

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Blended with a *metallic lead base*, WECO STEEL-AID will not harden. It will withstand pressures and temperatures. STEEL-AID allows joints to be broken out after great lengths of service. Recommended especially for drill collars, Xmas Trees, testing racks or any thread connection where extremely high pressures are encountered.

WECO NO-GALL is made with a *metallic zinc base* for longer protection of thread-to-thread contact on tool joints. It prevents galling . . . assures longer thread life on long strings of joints.

WECO Thread Compounds have been giving unfailing service year after year in the toughest services. Buy the best . . . buy WECO Thread Compounds.

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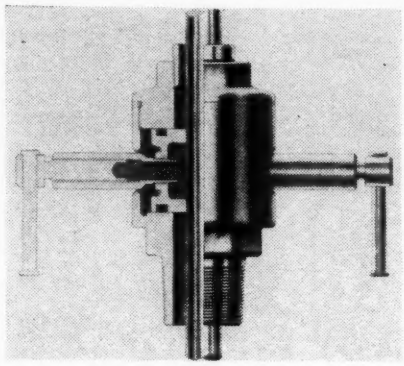
WECO
Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

oped especially for the purpose, maintains a positive fluid and pressure seal around the polished rod under the most severe conditions, it is asserted.

The gland, which "floats" with the rod, seats on a shoulder inside a housing and is held in position vertically by a threaded cap screwed in the top of the housing. O-rings in the gland effect a pressure seal between the gland and housing, so that all fluid and pressure is confined to the inside of the gland. Plastic guns, threaded into the gland, extend through the housing and permit plastic to be inserted, tightened, and added as necessary, without shutting in the well. The plastic guns are not connected to the housing in any manner—they extend through large openings in the housing and are free to move with the gland as it floats to compensate for any off-center movement of the polished rod. A bronze wear bushing, screwed in the top of the cap, limits lateral movement of the rod, preventing contact with the tubing and fittings and eliminating wear on the gland.



Kinzbach floating gland

Kinzbach Type C polished rod stuffing-boxes are available with 2½-in. lower connections, for all popular sizes of polished rods. They are designed for working pressures up to 500 lb. per sq. in.

(14) *Mercuryless meter*

The Arcco meter, manufactured by the American Recording Chart Company, Los Angeles, California, measures gases and liquids under high or low line pressures. In operating principle it embodies all the time-proved advantages of its predecessor the Arcco-Anubis meter, according to its makers. No mercury or other liquid column is employed. There are no pivots, bearings or stuffingboxes, consequently no leakage.

The Arcco meter is of the orifice type. Differential pressure, upon which all orifice or contracted tube measurements are based, acts upon a strong, tough, and highly resilient spring phosphor-bronze bellows. Under this influence the bellows is distended, its distension being opposed by the elastic resistance of a "torsion tube" that transmits motion to the recording mechanism outside the pressure chamber without the necessity of any opening whatever through the meter walls.

In construction the new Arcco is lighter than the Anubis meter and in addition possesses many other refinements. Its low weight facilitates portability. It is extremely accurate and responsive yet rugged in design so that even the roughest handling has no effect on its calibration. The instrument is ideal for quick checking in the field upon the accuracy of other meters or for continuous recording, it is asserted.

(15) *Hughes rock bits*

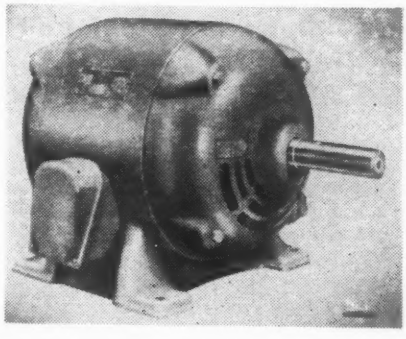
A surface approaching the hardness of the diamond is applied by a new atomic-hydrogen welding process to the teeth of a rock bit drill at the Hughes Tool Company plant in Houston, Texas. Most recent models of the Hughes rock bit have penetrated the earth below 16,000 ft. The atomic-hydrogen process differs from other arc-welding processes in that the arc is formed between two electrodes, rather than one electrode and the work.

(16) *All-steel motor*

All steel construction—frame, feet, and end brackets—makes possible a squirrel cage induction motor that is 35 per cent smaller in size than its predecessor without sacrifice of electrical properties. In addition, it is lighter, more rigid, and can withstand greater impact.

Known as the "Life-Line" motor, it is available in drip-proof, splash-proof, and fan-cooled construction. Its special features are: A frame rolled from steel plate that is as thick as it would be if made from cast iron; feet and end brackets of heavy pressed steel; all-welded construction; self-sealed, pre-lubricated ball bearings that provide effective lubrication for five years or longer without repacking; rounded corners at top and bottom of slot cells that eliminate creasing cell insulation; special synthetic resin covered wire for coils; dynetrically balanced rotor, and interchangeability of parts as there are only 13 parts and subassemblies.

It is available in sizes from ½ to 20 hp.; in voltages of 208, 220, 440, and 550; in two and three phase; in frequencies and speeds of 60 cycle—3500, 1750, 1150, and 865 r.p.m., of 50 cycle—2920, 1450, 965, and 720 r.p.m., and 25 cycle—1450 and 725 r.p.m.; and in NEMA Standard dimension frames 203 to 326. Westinghouse is the manufacturer.



Acme
Drillers Knowing Tools Best—
Choose Acme First—for Toughest Test
Fig. 102
Acme Jars, Rope Sockets and Bits will save time, save money and temper-fits! Why postpone that better day when you'll adopt them to reach quicker the elusive "pay"? . . . See our catalog in Composite Catalog. See your favorite supply-man. Or ask us for full information.
Fig. 115 — Acme Presser Swivel Socket, Especially designed for wire cable use. Highest grade forging steel — Pyrometer controlled, heat-treated—for maximum toughness — longest wear-resisting.
Fig. 115
Fig. 107 — Acme Rein Type Welded Drilling Jar. Safest defense against costly fishing jobs. Finest known jar steel, converted to your better use by life-time jar-makers. Acme Jars cost less per foot of hole drilled.
Fig. 109
Fig. 109 — Acme Drilling Bits. Forged to balanced proportions, from highest quality bit steel . . . THAT and Acme's 46 years of cumulated (PRICELESS) craftsmanship assure you the world's champion bit.
Acme Tools Aren't Wrapped In Cellophane — But . . .
According to modern standards in technology, to better meet man's exacting needs, for greater speed and more efficient and economical productivity — "more feet of less costive hole through Nature's resistive formations", to use oil country lingo—Acme Drilling Tools have long earned the highest acclaim of drillers who know best . . .
The reason for the deciding difference is simply that priceless element, which nearly a half-century has added for YOUR greater protection — profit — peace-of-mind . . . The longer experienced heads, more skilled hands, and the pride-of-craftsmanship which fashions the better selected, heat-treated, precision machined forgings . . .
Consider well, then, the ever-dependable name—ACME before you buy.
Acme Fishing Tool Co.
PARKERSBURG, W. VA.
Export Office: 19 Rector St., New York 6, N. Y.

BORN
A Year Earlier

Remember the first solo flight, New York to Paris, May 20-21, 1927? Seems sort of ancient now, but it proved the principle of man's mastery over the air. Well,

SAND-BANUM

"The Entirely Different Boiler and Engine Treatment"

BORN IN 1926

proved the mastery over boiler scale and corrosion. Its 20 year record in the automatic elimination and prevention of boiler scale and corrosion shows reduced fuel cost and increased power.

Sand-Banum comes in 16 oz. cans, ready to use as is. It's safe to personnel and equipment.

It results in longer equipment life and reduces shut-downs, despite water or operating conditions.

BE A SKEPTIC

TODAY—ask us to prove this to your entire satisfaction.

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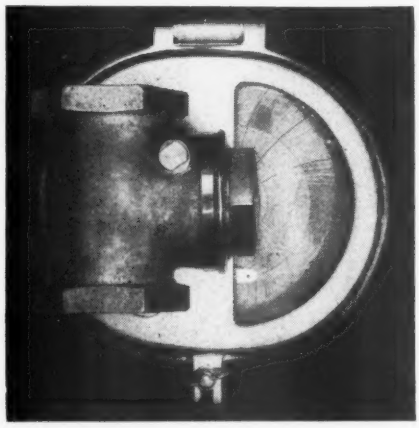
Stocks carried by
WESTERN SAND-BANUM COMPANY
Houston, Texas
and at other convenient points including leading supply houses

Export Representatives
PETROLEUM MACHINERY CORP.
30 Rockefeller Plaza New York 20, N. Y.

(17) *Well status recorder*

The PSJ recorder is an automatic recorder of oilwell performance that provides a permanent minute-by-minute record of well action. It is simple to install on any part of the line between stuffingbox and tank or sump and will supply permanent chart records by the day or week, according to the manufacturer, Elmer E. Jones, Bakersfield, California.

The PSJ recorder instantly detects and permanently records change of stroke, plunger, tubing, need for bailing, experimental work fluctuations, exact time and



length of such fluctuations, approximate total volume and exact comparative volume of material produced, length of time spent in servicing well; and will indicate fluid changes, it is stated. The PSJ recorder uses no ink and is adapted for either 1-in. or 2-in. indications. It is ruggedly constructed, having a cast aluminum case attached to a standard swinging gate, 125-lb. 2-in. check valve. It contains mechanical linkage from the stylus, which measures and records the gate position on a 24-hr. or 7-day wax surfaced chart, which is turned by a hermetically sealed Macknic chart clock. It supplies accurate, permanent history of wells actively on 24-hr. or 7-day on a 6-in. chart, the manufacturer asserts.

(18) *Flow regulator*

The Waterman Engineering Company, Evanston, Illinois, announces an automatic flow regulator for hydraulic systems where unlimited flow in one direction is required, with a predetermined rate of flow in the opposite direction.

Hydraulic machine tools and lift devices can be perfectly controlled to predetermined speeds and insured against the sudden release of hydraulic pressure, it is said.

(19) *45-Volt battery*

A new 45-volt B battery having only half the weight and size of prewar models has been developed by "Eveready" Batteries for use with electronic industrial test equipment, tripping circuit breakers, portable amplifiers, radio transmitters, commercial motion picture projection machines, electronic and telephone devices, and other equipment that will benefit by reduced weight and size of its power source. Use for the battery may also be found in physics and chemical laboratories, and as emergency or standby power for lighting or transmission installations.

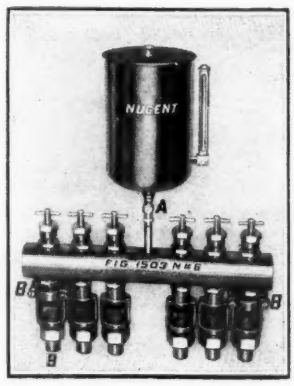
The new battery utilizes the famous "Mini-Max" battery principle originally developed to power the tiny radio sets in the proximity fuses of anti-aircraft and artillery shells. The "Mini-Max" battery has the carbon electrode printed ink-thick, in effect, on the zinc plate, which greatly condenses the size and increases the efficiency of the battery.

The new 45-volt B battery displaces only 76.6 cu. in. and weighs only 4 lb. 4 oz.

(20) *Multiple oiler*

The latest addition to the line of filter and lubrication specialties manufactured by Wm. W. Nugent and Company, Inc., Chicago, is a new heavy-duty multiple oiler. This new unit has a reservoir tank capacity of three pints, and is available with a string of sight feed valves in multiples of from 2 to 23 feeds. It is designed to be used on any machine that requires drop feed or small stream. Following are some of the design features of this new product:

Removable strainer in each sight feed, together with the glass, may be removed for



cleaning without the use of tools, or without stopping the flow of oil. (No piping or tubing to remove).

Minimum amount of glass used—well protected. (Reservoir tank gauge glass has protecting sleeve along its entire length).

Oiler is equipped with supporting clamp having threaded studs to screw into the machine to be oiled.

Dust-tight reservoir cover, easily removed for filling operation.

Union outlets on each feed are available in sizes from ⅛ in. to ⅜ in. female iron pipe screw threads.

(21) *Unit substations*

High voltage incoming line, transformer, and low voltage feeder sections are combined in one compact assembly in the new All-In-One unit substations built by Wagner Electric Corporation of St. Louis, Missouri. Installation is simplified, as the units are delivered ready to connect.

All-In-One unit substations are standardized in ratings 100, 150, 200, and 300 kva., 3 phase, 60 cycles. Choice of combinations of different types of transformers and high and low voltage equipment makes them suitable for a wide range of applications.

(22) Cleansing compound

Derived from a basic ingredient of petroleum origin is a new cleansing compound of unusual efficiency, just perfected by Standard Oil Company of California. Tests have shown this new product of petroleum chemistry to possess markedly superior qualities for laundering, dishwashing, and other common household uses, as well as a large number of industrial purposes, the manufacturer states.

The compound was discovered and perfected by California Research Corporation, the company's research subsidiary. Oronite

McKISSICK

CAT LINE SNATCH BLOCK

The McKissick Cat Line Snatch Block is an all steel block primarily for severe service encountered around drilling rigs. It is suitable for all heavy duty service with 1¼ or 1½ inch manila rope. It has forged steel shells, hooks, links and trunion. The steel sheave, large center pin, Alemite lubrication and high speed bronze bearing are other McKissick features.

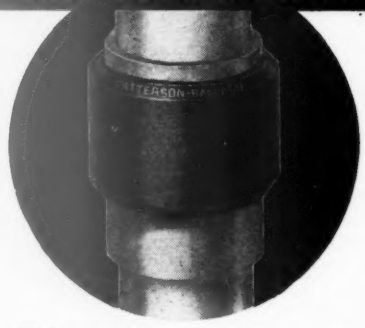
Catalog on Request

McKISSICK PRODUCTS CORPORATION

BOX 2496

TULSA, OKLAHOMA

"Best Bet Yet"
SAVE YOUR TUBING!



Tubing collars worn by contact with casing steal the profit out of pumping. Patterson - Ballagh Plastic Tubing Proteetors prevent both collar and casing wear. Oil-proof, wear-resistant, insulating. They are cemented to the collar under pressure and will not come off. Made in all sizes. End your tubing troubles. CALL in your Patterson-Ballagh man.

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92 Liberty St.
NEW YORK 6

"... AND, MAC, PLEASE LOOK INTO THAT "COMPLETE PACKAGE" REFINERY"

SEE PAGE 40

Chemical Company, the petroleum chemical subsidiary, participated at various stages in development of the finished product and will handle the marketing of it.

Many laboratory tests were made before the product was perfected, and the results were further verified by submitting quantities to others for testing under various conditions of actual use.

The finished compound consists of white, free-flowing particles, similar to various soap powders, and is used in much the same way. In performance it reveals outstanding qualities.

A small amount foams up into abundant suds in any kind of water, hard or soft. (It makes an excellent bubble bath.) Grease and dirt vanish readily. Glassware dries clear and sparkling without wiping. No taste or odor is left.

Fine fabrics and woolens are quickly and thoroughly laundered, with no harm to the most delicate materials.

Among the industrial uses a few are: Cleaning dairy and food processing equipment and containers, and general plant sanitation; various purposes in leather, textile, pulp and paper manufacture; in ore processing as a flotation medium; in insecticides and weed killers to improve wetting and spreading.

Production of the compound on a commercial scale has now begun, and the output will be increased rapidly as new facilities and plant additions are completed, and as marketing operations are expanded.

New manufacturing facilities already provided and others scheduled to be built will represent an investment of several million dollars.

Oronite Chemical Company will distribute the product direct to industrial users. Marketing arrangements in the household field are being consummated by Oronite through established trade outlets.

This development of petroleum as raw material for a cleansing agent has importance in relation to the world food shortage, as it helps to conserve fats and vegetable oils commonly used in manufacture of soap products.

(23) *Portable compressor*

The Davey Compressor Company, Kent, Ohio, has announced a new Model 60V portable compressor for 1947, according to Paul H. Davey, president.

This new unit is available in standard skid and 2-wheel pneumatic-tired trailer mounting styles, also with flanged wheels for railroad work. It is likewise offered (complete with a Davey Heavy Duty Power Take-off) as an "Auto-Air" compressor for truck mounting. The compressor produces 60 cu. ft. per min. at 100-lb. pressure and is designed for heavy duty service.

The compressor has one low pressure cylinder with 5¾-in. bore and 4½-in. stroke. The high pressure cylinder has 3⅝-in. bore. Operating speed is 1225 r.p.m.

Weight of the 2-wheel model is 2100 lb. Over-all dimensions are: length, 88 in.; width, 62 in. (tire track line, 52½ in.); height, 51½ in.

The compressor (in skid, trailer and railway models) is powered by a Hercules IXB engine.

(24) Burndy Scrulugs

A new large size Scrulug has been added to the family of low-cost Burndy solderless lugs, it is announced. This new size, the KPA34, accommodates a range of wire and cable sizes from No. 4/0 wire to 500 Mcm. cable. The Scrulug is quickly installed by simply tightening the clamping bolt, which forces a pressure bar upon the cable. Despite the fact that a large range of wires and cables will be accommodated, it was designed to have the operating characteristics of the largest cable. Formed from pure copper and brazed for added mechanical strength, the conductivity, pullout value, and the performance of the Scrulug greatly exceed the Underwriters' Laboratories, Inc., requirements, it is asserted. It is announced by the manufacturer, Burndy Engineering Company, Inc., that these connectors are stocked in their many distribution points.

(25) *Hydraulic governors*

A new principle of governing, made possible by combining the time-honored principles of hydraulics and centrifugal force, has been announced by the Milwaukee Lock and Manufacturing Company, Milwaukee, Wisconsin. Four standard types are now in production: (1) Automotive, (2) constant speed, (3) overspeed shutoff, and (4) universal.

"Milwaukee" hydraulic governors can be adapted to any gasoline or diesel engine. They are available in all standard sizes. The outstanding feature of these governors is their flexibility of power take-off in relation to governor control. This flexibility permits the power source for driving the pressure generator to be situated as far as 30 ft. from the governor control without loss of operating efficiency. Other features are: Revolutionary, tamper-proof design, interchangeability between different throttle body sizes using the same pressure generator, ease of installation, and economy.

(26) *Landis Chasers*

The Landis Machine Company, Waynesboro, Pennsylvania, recently developed a double diameter tangential type ground thread chaser.

The chasers have all surfaces and the thread form ground after hardening and are guaranteed to hold within a class three fit on the two diameters.

It is essential that the threads produced on the two diameters be of the same form and pitch.

There are limitations in the difference between the two diameters for which the chasers can be supplied and each set of chasers must be engineered for the threading job on which it will be used.

Both diameters of threads on the work piece should be of a fairly short length to satisfactorily use the double diameter chaser.

(27) *Combination welder*

A new compact combination gas-electric drive Hobart welding machine consists of the standard 300-amp. generator and 20-hp. induction motor mounted on a heavy solid shaft coupled to a Chrysler 6-cylinder industrial engine through an over-running clutch coupling. This coupling allows the gasoline engine to drive the welding generator positively. Should the gasoline engine be stopped and the generator be driven by the electric induction motor, however, the clutch will over-run, or free wheel. This action is entirely automatic—no levers or pins are required to be moved.

The induction motor is wound for dual voltage 220/440. This changeover is accomplished by throwing a double-throw knife switch either to the 220-volt position or the 440-volt position. The motor is started by means of a pushbutton across-line contactor that is designed to work in conjunction with the voltage changeover knife switch so that no changes are necessary in the contactor for 220-volt or 440-volt operation.

CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA

Takes a lot of your work out of cutting pipe...this

fast-action 4-wheel

RIDGID pipe cutter

Regular Heavy-Duty RIDGID *Cutters in 5 sizes.*

Good reasons why this 4-wheel RIDGID pipe cutter is such a favorite everywhere. It cuts pipe fast and clean with least effort. Designed with short handle to work in tight quarters, it cuts quickly even where you have room only for a quarter turn. Special malleable body assures alignment, it always cuts true — every cutter factory tested. You'll like this efficient worksaver RIDGID — ask for No. 42 (1/2" to 2") or No. 44 (2 1/2" to 4") at your Supply House.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

TRADE LITERATURE

Publications listed are sent free upon request.

(28) *Maintenance methods*

Oakite Products, Inc., New York, New York, has isued a digest of 88 maintenance and related jobs generally performed in the producing, refining, and marketing divisions of the petroleum industry on which Oakite cleaning materials and methods are being used to speed up this work and increase operating efficiency of equipment.

(29) *Lubricating oil additives*

American Cyanamid Company, New York, New York, has issued a booklet describing its new dithiophosphates, offered under the trade name Aerolube dithiophosphate additives for lubricating oils.

(30) *Steam condensers*

Catalog No. 1461, "Steam Condensers," has been released by C. H. Wheeler Manufacturing Company, Philadelphia, Pennsylvania. In addition to being well illustrated with photographs of equipment, the bulletin also contains many useful tables and charts.

(31) *Cycling plant reprint*

Clark Bros. Co., Inc., Olean, New York, has issued a reprint of the article "Volatile Hydrocarbons Separated From Condensate at Sheridan Cycling Plant," by William J. Davis. The article describes the Shell Oil Company's cycling plant in the Sheridan field, Texas. It is reprinted from *The Petroleum Engineer*.

(32) *Indirect heaters*

Part No. 1, Section No. 3 of General Catalog No. 46 of Black, Sivalls and Bryson, Inc., Oklahoma City, has been released by the company. This section is concerned with indirect heaters.

(33) *Marsh gauges*

A new bulletin illustrating and describing its line of gauges for the oil industry has just been released by the Jas. P. Marsh Corporation, Chicago, Illlinois.

(34) *"Successful Cementing"*

"Successful Cementing" is the title of a bulletin published by B and W, Inc., Long Beach. The bulletin contains an illustrated discussion of what constitutes a successful cementing operation and the part played by B and W wall cleaning guides.

(35) *Ideco oilfield equipment*

Ideco oilfield equipment and supplies are shown in a catalog issued by International Derrick and Equipment Company. Included are rotary drilling equipment, cable tool drilling equipment, production equipment, servicing equipment, and miscellaneous items used in the industry.

(36) *Armored rotameters*

Armored rotameters for high pressure fluid flow rate measurement and control are described and illustrated in Catalog Section 40-A, issued by Fischer and Porter Company, Hatboro, Pennsylvania.

(37) *Vertical pump*

A new 20-page bulletin "Peerless Vertical Close Coupled Turbine Pumps" is devoted in its entirety to describing and illustrating the specialized application of Peerless turbine pumps to industrial, municipal, engineering, and agricultural installations where short pump settings are encountered and where there is a strong necessity for deep well turbine pump power and capacity in these applications.

(38) *Cooper-Bessemer engines*

The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, has issued three more of its compact four-page bulletins in the series covering its line of stationary units. All these apply to the Type JS engine, one giving the specifications for the diesel, one for the gas diesel, and the other for the gas engine.

(39) *Fluor pulsation dampener*

The Fluor Corporation, Ltd., Los Angeles, has issued a new bulletin entitled "The Effects and Corrections of Gas Pulsation Problems." This bulletin contains an authoritative article by Foster M. Stevens, research engineer in the company's development department.

In his article, Stevens discusses the many different gas pulsation problems and some of the attempts made to correct them. He also discusses the Fluor pulsation dampener in detail. This equipment completely changes pulsative flow into a steady stream. The bulletin is illustrated with many pictures, charts and diagrams.

(40) *Ideal type 50 rig*

The Ideal Consolidated Rig Type 50 is fully described in a new bulletin issued by The National Supply Company. The Ideal Type 50 Rig is constructed for fast and economical drilling to a nominal depth of 5,000 ft. and its six hoisting speeds and three rotary speeds with reverse give it great flexibility. The rig may be driven by two engines having combined maximum output up to 425 hp. The bulletin has 12 illustrations, a dimensional drawing, a shaft speed diagram, and gives complete engineering and operating specifications.

(41) *Diesel cooling*

A new 20-page booklet, titled "Diesel Engine Cooling Systems," has been released by the Binks Manufacturing Company, Chicago, Illinois. Profusely illustrated with pictures, diagrams and blueprints, the booklet will help solve many of the problems encountered every day in diesel engine cooling. It shows how water jacket scale, overheating, costly break-downs, and insurance rates can be greatly reduced or entirely eliminated.

(42) *Convertible power shovel*

An informative 36-page catalog has been published by Buckeye Traction Ditcher Company, Findlay, Ohio, on the Buckeye convertible power shovel, which is also widely known as the Buckeye Clipper.

The advanced features of this versatile unit—including vacuum power control, non-clogging crawlers, balanced weight, and fast, positive crowd, hoist, swing and travel—are pictured and described in detail. The bulletin demonstrates how these characteristics result in greater work capacity with lower power consumption.

Also illustrated and described is the quick and ready convertibility from a power shovel to trench hoe—dragline or crane, clamshell, hook block or magnet—or pile driver. The maker's truck crane and high lift shovels are also pictured and described.

(43) *Proportioning equipment*

Bulletin No. 1200, an attractive new catalog, has just been issued by % Proportioneers, Inc., %, manufacturers of automatic proportioning equipment. This new catalog is a handy reference book and contains a wealth of material dealing with automatic flow responsive equipment and methods in continuous process operation. Photographs of chemical proportioning equipment and typical installations are supplemented by many flow diagrams and detail drawings.

(44) *Metal packings*

An illustrated folder describing various types of metal packings has been issued by the France Packing Company, Philadelphia, Pennsylvania. This folder, entitled "Industrial Packing," describes the metal packing most frequently used. The desirability of packings made to fit standard stuffing boxes is obvious when their advantages are understood as described in this folder, it is pointed out.

(45) *Oil purification*

Volume 2, No. 3 of *Clean Oil*, a pictorial publication devoted to oil purification, issued quarterly by Honan-Crane Corporation, is now available. This issue is devoted almost entirely to case histories of oil purification equipment, covering specific applications.

(46) *Control valve bulletin*

"Pneumatic Control Valves and Controller Accessories" is the title of Bulletin 277-1, a new 36-page publication of The Foxboro Company, Foxboro, Massachusetts, makers of industrial instruments and equipment for measurement and control. The company's previously familiar valve bulletin has been completely revised and much new material has been added, to give the present bulletin maximum convenience and usefulness.

(47) *Book on preformed wire rope*

When a producer begins to think that everyone knows of his product, how it is made and what it does—that individual is due for an abrupt awakening. At least that is the opinion of the Preformed Wire Rope Information Bureau, which has just published a new book "Preformed Wire Rope—What it is—What it does."

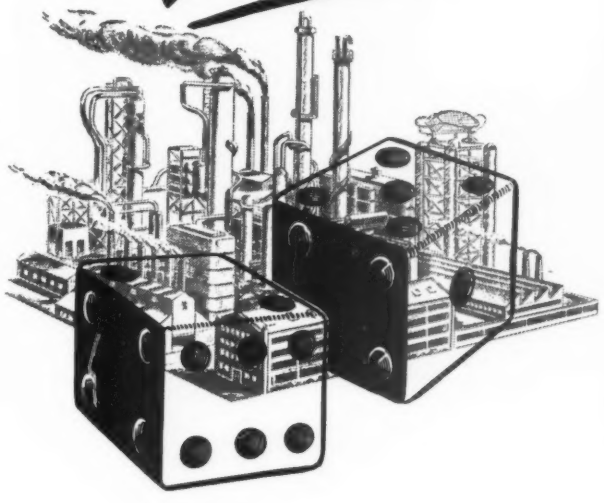
Although preformed wire rope has rapidly advanced in universal acceptance since its introduction in 1924, any survey, according to the Bureau, would turn up many wire rope users who never heard of the word "preformed." This is due largely to the heavy turnover in industrial personnel during the last five years. Realizing this, the Bureau has issued a book that capably answers the elementary question: "What is preformed wire rope?"

(48) *Fluid cracking catalyst*

American Cyanamid Company, New York, New York, has issued a booklet describing its new microspheroidal synthetic fluid cracking catalyst. The product is offered under the trade name of Aerocat Grade MS-A Synthetic Fluid Cracking Catalyst.

DRIOCEL IS A

"Natural"



for a TOUGH TASKMASTER

Industry today expects more from the desiccants it buys. It requires that they dry a greater variety of gases and liquids to more rigid specifications. Efficiency and economy, too, are increasingly important. This calls for a versatile adsorbent, and Driocel has unique features that make it a "natural" for many difficult as well as routine drying jobs.

One important characteristic of Driocel is its low iron content . . . *held to 3% or under*. This means not only a longer adsorbent life, but it means also that higher Dry Gas Capacity values are maintained through repeated regenerations. Drying operations can be conducted in such a manner that low-iron Driocel is unaffected by appreciable quantities of hydrogen sulfide. In fact, Driocel is even used in the drying of H_2S with satisfactory results.

This activated bauxite desiccant is successfully drying hydro-carbon gases and liquids, liquid organic chemicals, electrical oils, hydrogen and compressed air. These installations involve wide pressure, temperature, and moisture ranges. In most cases, Driocel meets these conditions with superior performance and long life. And, the fact that Driocel's price is substantially lower than other well known solid desiccants is noteworthy.

Perhaps your drying problems can be solved, or your processing improved by using Driocel. Why not consult us? Our work with bauxite desiccants has been extensive and we would be glad to assist. Address: Attapulgus Clay Company (Exclusive Sales Agent), Dept. J, 260 South Broad Street, Philadelphia 1, Pa.

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ACTIVATED BAUXITES • SUPPORTED CATALYSTS • CATALYST CARRIERS • ABSORBENTS AND DESICCANTS

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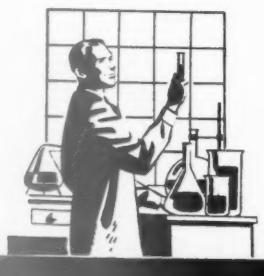

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= THE BEST IN DEHYDRATION

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TRETOLITE COMPANY

Manufacturing Chemists

St. Louis 19, Missouri — Los Angeles 22, California

DEHYDRATING DESALTING

THE *Petroleum* Engineer's CONTINOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 113

A VALUABLE and regular feature of *The Petroleum Engineer,* the Continuous Tables, now in their tenth year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer.* Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

The Continuous Tables have developed as a result of suggestions for new tables, direct contributions and improvements to existing tables by members of the pertoleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-14, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue; 73-79, inclusive, in the January, 1944, issue; 80-82, inclusive, in the April, 1944, issue; 83-85, inclusive, in the July, 1944, issue; 86-88, inclusive, in the October, 1944, issue; 89-91, inclusive, in the January, 1945, issue; 92-94, inclusive, in the April, 1945, issue; 95-97, inclusive, in the July, 1945, issue; 98-100, inclusive, in the October, 1945, issue; 101-103, inclusive, in the January, 1946, issue; 104-106, inclusive, in the April, 1946 issue; 107-109, inclusive, in the July, 1946, issue; 110-112, inclusive, in the October, 1946, issue.

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Linde Air Products Co. (sheet 1)	236	Nov.	P 615.2
Nash Engineering Co. (sheet 4)	232	Nov.	P 771.214.736.

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CHART FOR ESTIMATION OF NATURAL GAS RESERVES

This chart is based on data contained in the article, "Effect of Reservoir Depth on Gas Reserves," by K. Marschall Fagin as published in the October, 1945, issue of *The Petroleum Engineer*, pages 256 to 260, clusive.

*This chart is applicable to an acre-ft. of gas sand that has 9801 cu. ft. of effective porosity and produces 0.6 gravity gas.

**Standard cu. ft. at 14.65 lb. per sq. in., abs., and 60°F., using a terminal well head pressure of 125 lb. per sq. in., ga.

***The depth scale is applicable only to initial gas field pressures that are "normal," that is equivalent to a hydrostatic head of 435 lbs. per 1000 ft. of depth.

EXAMPLE:

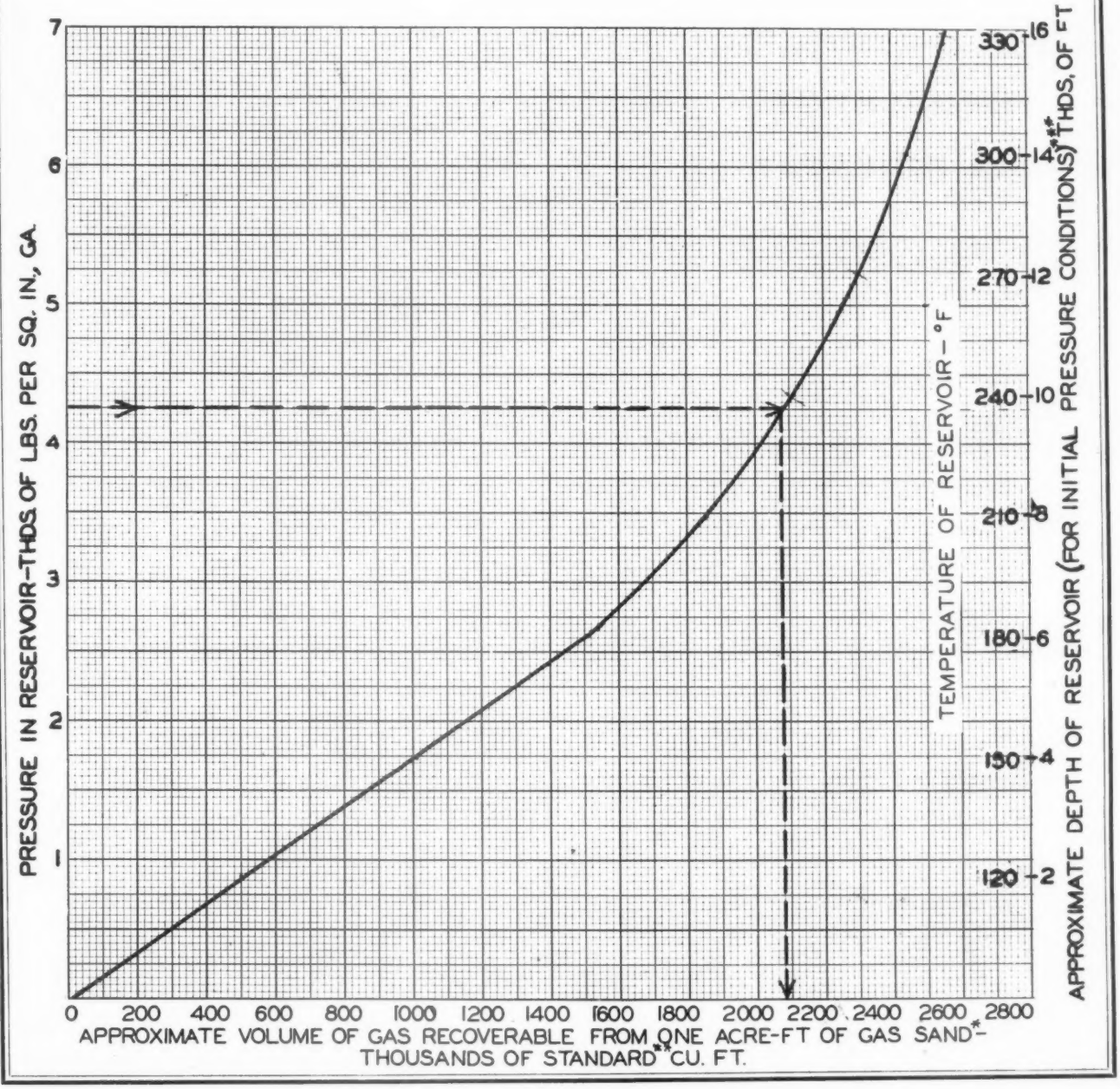
Given: A new gas reservoir with an initial pressure of 4250 lbs. per sq. in. ga., having sand with 9,801 cu. ft. of effective porosity per acre-ft., reservoir temperature of 237°F., and producing 0.6 gravity natural gas.

Required: An estimate of the ultimate recovery of gas per acre-ft.

Solution: Enter the chart from the 4250 lb. point on the pressure scale (as indicated) and proceed to the intersection with the curve. The answer, 2080 cu. ft. is found on the "recovery" scale directly below the intersection.

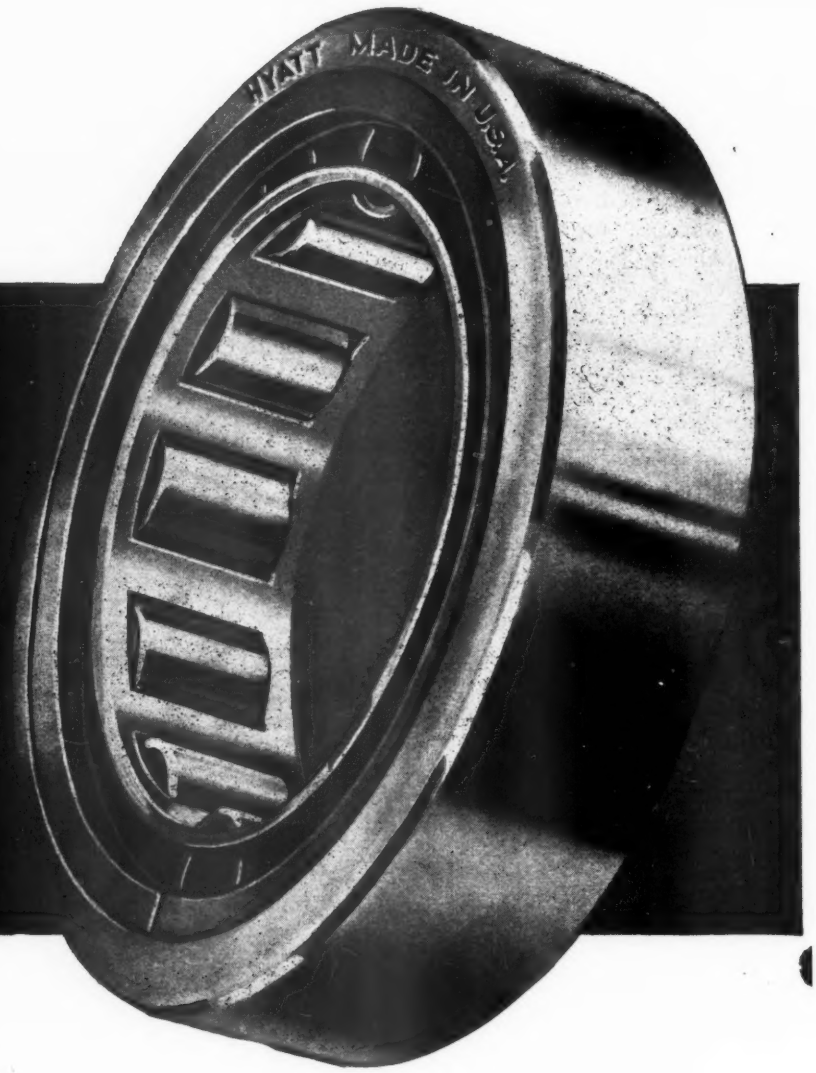
Note: The effective porosity of the gas sand = 43,560 cu. ft. × per cent porosity × (100 — per cent connate water).

If the effective porosity of the gas sand in question is more or less than 9,801 cu. ft., the recoverable volume of gas will be proportionately more or less.


PRESSURE IN RESERVOIR-THDS. OF LBS. PER SQ. IN., GA.
7
6
5
4
3
2
1
0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800
APPROXIMATE VOLUME OF GAS RECOVERABLE FROM ONE ACRE-FT OF GAS SAND*-
THOUSANDS OF STANDARD** CU. FT.
TEMPERATURE OF RESERVOIR — °F
330 300 270 240 210 180 150 120
16 14 12 10 8 6 4 2
APPROXIMATE DEPTH OF RESERVOIR (FOR INITIAL PRESSURE CONDITIONS)*** THDS. OF FT

Rollers Roll—

THROUGHOUT ALL INDUSTRY



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HYATT ROLLER BEARINGS

THERMODYNAMIC PROPERTIES OF PROPANE*

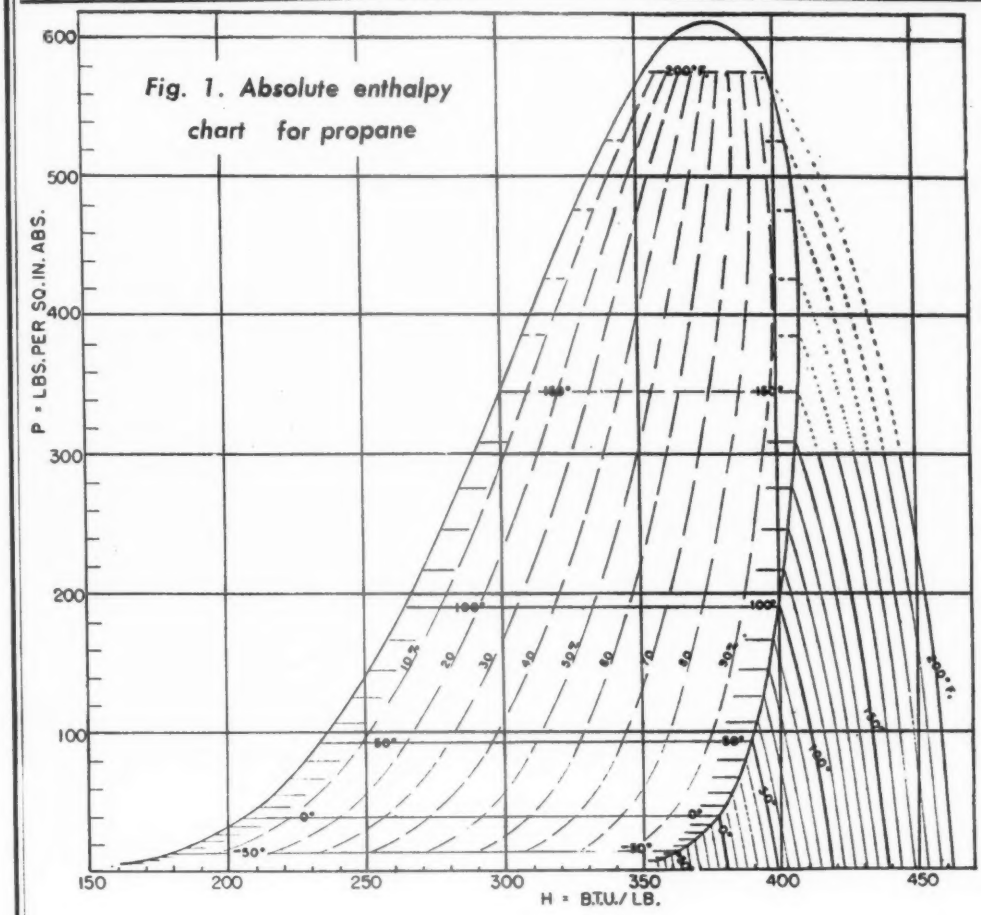

Fig. 1. Absolute enthalpy chart for propane

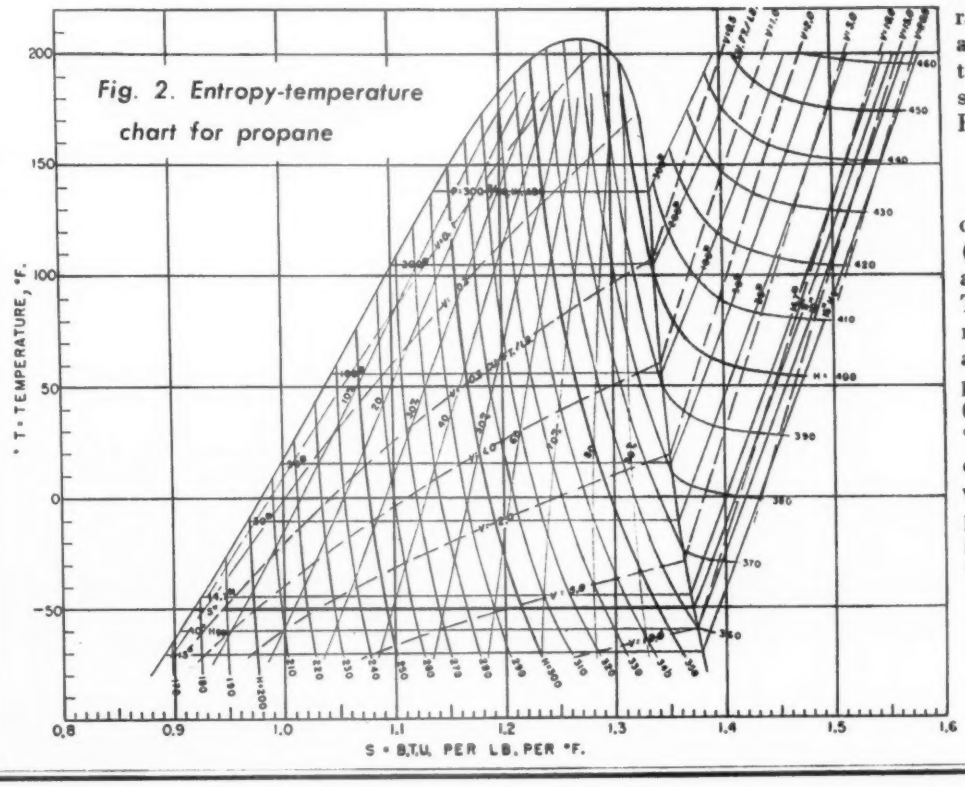

Fig. 2. Entropy-temperature chart for propane

*This series of charts and tables are taken from the paper entitled "Thermodynamic Properties of Propane," by Walter V. Stearns and Emmanuel J. George as published in *The Petroleum Engineer*, Reference Annual· July 1, 1943, after being presented before American Chemical Society, Detroit, Michigan, April 12-16, 1943, and published in *Industrial and Engineering Chemistry*, May, 1943.

Fig. 1 shows the change in heat content, or enthalpy (H) with pressure at constant temperature. The enthalpy of saturated liquid propane at —40°F. and 16 lb. per sq. in., absolute, is 183 B.T.U./lb., and the enthalpy of saturated propane vapor at the same temperature and pressure is shown to be 365.7 B.T.U./lb.

Fig. 2 shows the change in entropy (S) with temperature at constant pressure. The entropy of saturated liquid propane at —40°F. and 16 lb. per sq. in. absolute is 0.9315 B.T.U./lb./°F., and the entropy of saturated propane vapor at the same temperature and pressure is 1.3670 B.T.U./lb./°F.

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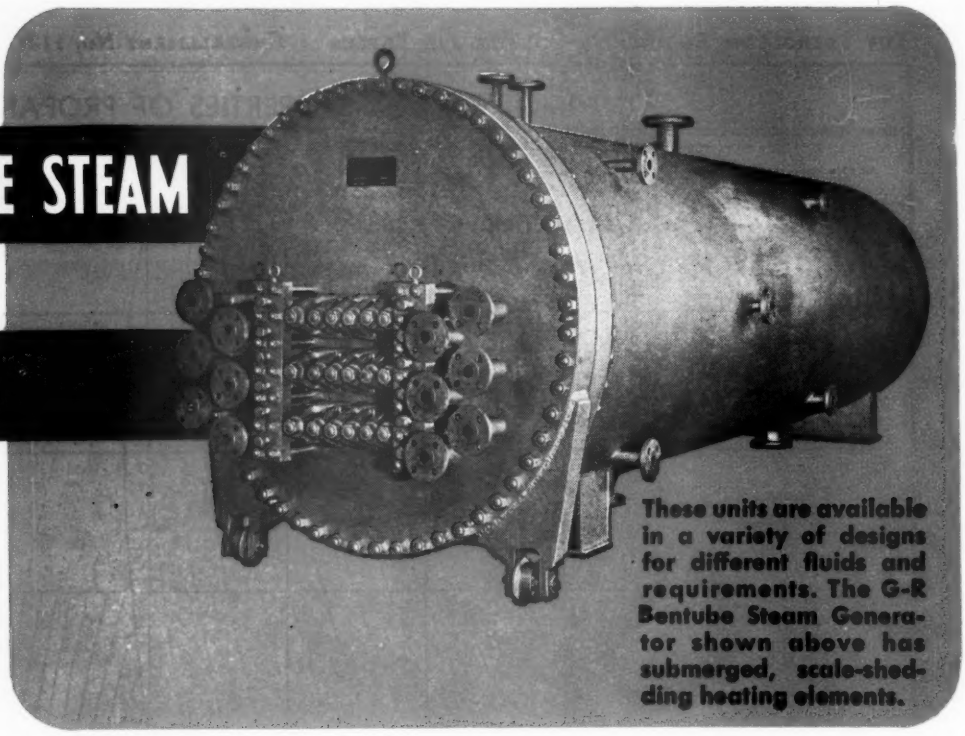

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THERMODYNAMIC PROPERTIES OF PROPANE*

TABLE I

Temperature data for saturated propane

Temperature t, ° F.	Pressure, Lb./Sq. In., Absolute, P	Pressure, Lb./Sq. In., Gage, gp	Volume, Cu. Ft./Lb. Liquid v	Volume, Cu. Ft./Lb. Vapor V	Density Liquid $(1/v)$, lb./gal.	Density Vapor $(1/V)$, lb./cu. ft.	Heat Content, B. T. U./Lb. Liquid h	Heat Content, B. T. U./Lb. Vapor H	Latent Heat L, B. T. U./Lb.	Entropy, B. T. U./Lb./° F. Liquid s	Entropy, B. T. U./Lb./° F. Vapor S
−80	5.65		0.0265	16.2	5.052	0.062	162.6	354.0	191.4	0.8794	1.3832
−78.75	5.87	18 in.[a]	0.0265	15.6	5.043	0.064	163.2	354.4	191.2	0.8812	1.3826
−78	6.00		0.0266	15.3	5.041	0.065	163.6	354.6	191.0	0.8821	1.3822
−76	6.32		0.0266	14.6	5.030	0.068	164.6	355.2	190.6	0.8847	1.3812
−75.9	6.35	17 in.	0.0266	14.6	5.030	0.068	164.6	355.2	190.6	0.8850	1.3811
−74	6.71		0.0267	13.8	5.020	0.072	165.6	355.8	190.2	0.8874	1.3801
−73.2	6.86	16 in.	0.0267	13.5	5.019	0.074	166.0	356.0	190.0	0.8884	1.3797
−72	7.18		0.0268	13.0	5.009	0.076	166.6	356.4	189.8	0.8900	1.3791
−70.7	7.35	15 in.	0.0268	12.7	5.002	0.079	167.2	356.5	189.5	0.8918	1.3785
−70	7.48		0.0268	12.5	4.998	0.080	167.6	357.0	189.4	0.8927	1.3781
−68.4	7.84	14 in.	0.0268	12.0	4.990	0.083	168.4	357.5	189.1	0.8949	1.3775
−68	7.91		0.0268	11.9	4.988	0.084	168.6	357.6	189.0	0.8954	1.3773
−66.1	8.32	13 in.	0.0268	11.3	4.978	0.088	169.8	358.1	188.5	0.8978	1.3766
−66	8.33		0.0269	11.3	4.978	0.088	169.7	358.2	188.5	0.8980	1.3765
−64	8.80		0.0269	10.8	4.968	0.093	170.7	358.8	188.1	0.9007	1.3756
−63.9	8.81	12 in.	0.0269	10.8	4.968	0.093	170.8	358.9	188.1	0.9008	1.3756
−62	9.28		0.0270	10.3	4.957	0.097	171.7	359.4	187.7	0.9033	1.3748
−61.9	9.30	11 in.	0.0270	10.3	4.957	0.097	171.8	359.5	187.7	0.9034	1.3748
−60	9.78	10 in.	0.02703	9.77	4.946	0.102	172.7	360.0	187.3	0.9060	1.3740
−58.1	10.28	9 in.	0.02709	9.35	4.936	0.107	173.6	360.5	186.9	0.9085	1.3732
−58	10.29		0.02709	9.33	4.936	0.107	173.7	360.6	186.9	0.9086	1.3732
−56.2	10.77	8 in.	0.02714	8.96	4.926	0.112	174.6	361.1	186.5	0.9108	1.3726
−56	10.80		0.02715	8.92	4.925	0.112	174.7	361.1	186.4	0.9111	1.3725
−54.4	11.26	7 in.	0.02720	8.59	4.917	0.116	175.6	361.4	185.8	0.9132	1.3719
−54	11.36		0.02721	8.51	4.915	0.117	175.8	361.7	185.9	0.9137	1.3717
−52.6	11.75	6 in.	0.02725	8.24	4.907	0.120	176.5	362.1	185.6	0.9154	1.3712
−52	11.95		0.02727	8.12	4.904	0.122	176.8	362.3	185.5	0.9162	1.3710
−51	12.24	5 in.	0.02730	7.93	4.898	0.125	177.3	362.6	185.3	0.9175	1.3706
−50	12.60		0.02733	7.73	4.893	0.129	177.8	362.8	185.0	0.9188	1.3702
−49.6	12.73	4 in.	0.02734	7.72	4.891	0.130	178.0	362.9	184.9	0.9193	1.3701
−48	13.20		0.02739	7.50	4.882	0.133	178.8	363.4	184.6	0.9213	1.3696
−47.9	13.22	3 in.	0.02739	7.44	4.883	0.134	178.9	363.5	184.6	0.9214	1.3696
−46.5	13.71	2 in.	0.02743	7.17	4.875	0.139	179.7	363.8	184.1	0.9232	1.3691
−46	13.85		0.02745	7.06	4.872	0.142	179.9	364.0	184.1	0.9238	1.3689
−44.9	14.2	1 in.	0.02748	6.90	4.866	0.145	180.4	364.3	183.9	0.9252	1.3686
−44	14.52		0.02751	6.74	4.861	0.148	180.9	364.6	183.8	0.9264	1.3683
−43.71	14.70	0	0.02752	6.66	4.860	0.150	181.36	364.76	183.5	0.9266	1.3682
−42	15.28		0.02757	6.42	4.850	0.156	181.9	365.2	183.3	0.9289	1.3676
−40	16.00	1.30	0.02763	6.16	4.839	0.162	183.0	365.7	182.7	0.9315	1.3670
−38	16.79	2.09	0.02769	5.92	4.828	0.169	184.0	366.3	182.3	0.9340	1.3664
−36	17.56	2.86	0.02775	5.66	4.818	0.177	185.1	366.9	181.8	0.9365	1.3658
−34	18.40	3.70	0.02782	5.44	4.807	0.184	186.2	367.5	181.3	0.9391	1.3652
−32	19.30	4.60	0.02788	5.22	4.797	0.192	187.3	368.0	180.7	0.9416	1.3646
−30	20.18	5.48	0.02794	5.02	4.786	0.199	188.4	368.6	180.2	0.9441	1.3640
−28	21.05	6.35	0.02800	4.82	4.775	0.207	189.4	369.2	179.7	0.9467	1.3634
−26	22.01	7.31	0.02807	4.63	4.764	0.216	190.5	369.8	179.3	0.9492	1.3628
−24	22.98	8.28	0.02813	4.44	4.752	0.225	191.6	370.3	178.7	0.9517	1.3622
−22	23.98	9.28	0.02820	4.25	4.741	0.235	192.7	370.9	178.2	0.9543	1.3616
−20	25.05	10.35	0.02826	4.06	4.730	0.246	193.8	371.5	177.7	0.9568	1.3610
−18	26.15	11.45	0.02833	3.90	4.719	0.256	194.9	372.1	177.2	0.9592	1.3604
−16	27.30	12.60	0.02839	3.76	4.708	0.266	196.0	372.7	176.6	0.9617	1.3599
−14	28.50	13.80	0.02846	3.61	4.697	0.277	197.1	373.2	176.1	0.9641	1.3593
−12	29.70	15.00	0.02852	3.47	4.686	0.288	198.2	373.8	175.6	0.9666	1.3588
−10	30.95	16.25	0.02859	3.33	4.675	0.300	199.4	374.4	175.0	0.9690	1.3582
− 8	32.23	17.53	0.02866	3.20	4.664	0.313	200.5	375.0	174.5	0.9714	1.3577
− 6	33.55	18.85	0.02873	3.08	4.652	0.325	201.6	375.5	173.9	0.9739	1.3571
− 4	35.00	20.30	0.02879	2.98	4.641	0.336	202.7	376.1	173.4	0.9763	1.3566
− 2	36.40	21.70	0.02886	2.86	4.629	0.350	203.8	376.7	172.8	0.9788	1.3560
− 0	37.81	23.11	0.02893	2.74	4.618	0.365	205.0	377.2	172.2	0.9812	1.3555
+ 2	39.30	24.60	0.02900	2.66	4.607	0.376	206.1	377.8	171.6	0.9836	1.3550
4	40.85	26.15	0.02908	2.56	4.596	0.391	207.2	378.3	171.1	0.9860	1.3545
6	42.50	27.80	0.02915	2.47	4.584	0.405	208.4	378.9	170.5	0.9884	1.3541
8	44.13	29.43	0.02923	2.38	4.573	0.420	209.6	379.5	169.9	0.9908	1.3536
10	45.85	31.15	0.02930	2.30	4.562	0.435	210.7	380.0	169.3	0.9932	1.3531
12	47.55	32.85	0.02938	2.22	4.550	0.450	211.9	380.6	168.7	0.9956	1.3527
14	49.35	34.65	0.02946	2.14	4.538	0.467	213.1	381.1	168.0	0.9979	1.3523
16	51.20	36.50	0.02954	2.08	4.526	0.481	214.2	381.6	167.4	1.0003	1.3518
18	53.10	38.40	0.02962	2.00	4.514	0.500	215.4	382.1	166.7	1.0026	1.3514
20	55.00	40.30	0.02970	1.93	4.502	0.518	216.6	382.6	166.0	1.0050	1.3510
22	57.05	42.35	0.02978	1.86	4.590	0.538	217.7	383.1	165.4	1.0073	1.3506
24	59.10	44.40	0.02986	1.79	4.477	0.559	218.8	383.6	164.8	1.0097	1.3502
26	61.25	46.55	0.02995	1.73	4.465	0.578	220.0	384.1	164.2	1.0120	1.3499
28	63.45	48.75	0.03003	1.67	4.452	0.598	221.2	384.6	163.5	1.0144	1.3495
30	65.70	51.00	0.03011	1.60	4.440	0.625	222.3	385.1	162.8	1.0167	1.3491
32	67.95	53.25	0.03020	1.54	4.427	0.649	223.4	385.6	162.2	1.0190	1.3487
34	70.33	55.63	0.03029	1.48	4.414	0.676	224.5	386.1	161.5	1.0213	1.3484
36	72.75	58.05	0.03037	1.43	4.401	0.699	225.6	386.6	160.8	1.0237	1.3480
38	75.20	60.50	0.03046	1.39	4.388	0.719	226.8	387.1	160.2	1.0260	1.3477

a—Inches of mercury vacuum.

(Continued on Sheet 3)

**Taken from paper by Walter V. Stearns and Emmanuel J. George published in The Petroleum Engineer, Reference Annual, July 1, 1943, after being presented before American Chemical Society, Detroit, Michigan, April 12-16, 1943, and published in Industrial and Engineering Chemistry.*

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THERMODYNAMIC PROPERTIES OF PROPANE*

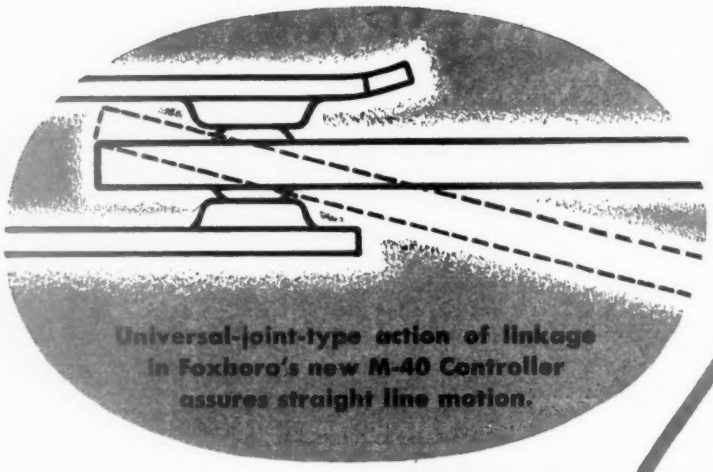
TABLE I

Temperature data for saturated propane (concluded)

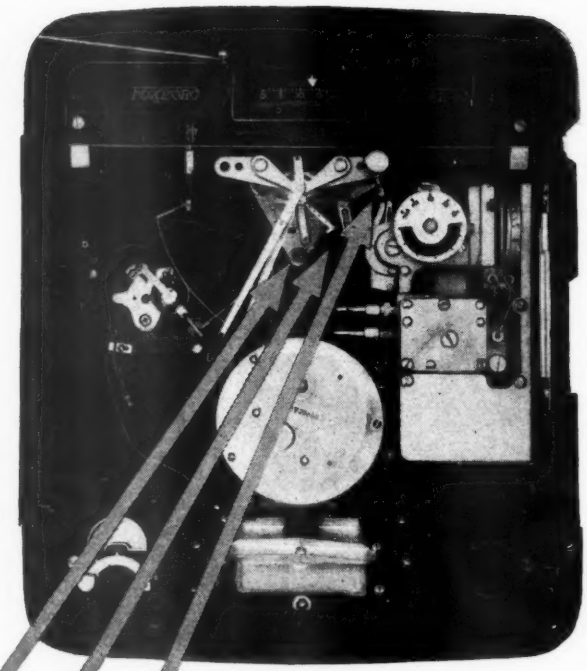
Temperature t, ° F.	Pressure, Lb./Sq. In. Absolute, P	Pressure, Lb./Sq. In. Gage, gp	Volume, Cu. Ft./Lb. Liquid v	Volume, Cu. Ft./Lb. Vapor V	Density Liquid $(1/v)$, lb./gal.	Density Vapor $(1/V)$, lb./cu. ft.	Heat Content, B. T. U./Lb. Liquid h	Heat Content, B. T. U./Lb. Vapor H	Latent Heat L, B. T. U./Lb.	Entropy, B. T. U./Lb./° F. Liquid s	Entropy, B. T. U./Lb./° F. Vapor S
40	77.80	63.10	0.03055	1.33	4.375	0.752	227.9	387.5	159.6	1.0283	1.3473
42	80.40	65.70	0.03064	1.28	4.362	0.781	229.1	388.0	158.9	1.0306	1.3470
44	83.05	68.35	0.03073	1.25	4.348	0.800	230.2	388.5	158.2	1.0329	1.3466
46	85.83	71.13	0.03083	1.21	4.335	0.826	231.4	389.0	157.5	1.0352	1.3463
48	88.65	73.95	0.03092	1.17	4.321	0.855	232.6	389.5	156.8	1.0375	1.3459
50	91.50	76.80	0.03101	1.14	4.308	0.877	233.8	389.9	156.1	1.0398	1.3456
52	94.50	79.80	0.03111	1.10	4.294	0.909	234.9	390.4	155.4	1.0421	1.3453
54	97.5	82.80	0.03121	1.07	4.281	0.935	236.1	390.8	154.7	1.0443	1.3450
56	100.6	85.9	0.03130	1.04	4.267	0.962	237.3	391.3	154.0	1.0466	1.3447
58	103.7	89.0	0.03140	1.01	4.254	0.990	238.5	391.7	153.3	1.0488	1.3444
60	106.9	92.2[a]	0.03150	0.984	4.240	1.016	239.6	392.2	152.6	1.0511	1.3441
62	110.2	95.5	0.03162	0.958	4.226	1.044	240.8	392.7	151.8	1.0534	1.3438
64	113.6	98.9	0.03174	0.932	4.213	1.073	242.0	393.1	151.1	1.0556	1.3435
66	117.1	102.4	0.03185	0.906	4.199	1.104	243.2	393.5	150.3	1.0579	1.3433
68	120.6	105.9	0.03197	0.880	4.186	1.136	244.4	394.0	149.5	1.0601	1.3430
70	124.3	109.6	0.03209	0.854	4.172	1.171	245.7	394.4	148.7	1.0624	1.3427
72	127.9	113.2	0.03221	0.832	4.158	1.202	246.9	394.8	147.8	1.0647	1.3424
74	131.7	117.0	0.03233	0.810	4.144	1.235	248.1	395.2	147.0	1.0669	1.3421
76	135.6	120.9	0.03245	0.788	4.131	1.269	249.4	395.6	146.2	1.0692	1.3419
78	139.6	124.9	0.03257	0.766	4.117	1.305	250.2	396.0	145.4	1.0714	1.3416
80	143.6	128.9	0.03269	0.745	4.103	1.342	251.9	396.4	144.5	1.0737	1.3413
82	147.7	133.0	0.03281	0.725	4.088	1.379	253.1	396.8	143.7	1.0760	1.3410
84	151.8	137.1	0.03293	0.704	4.074	1.420	254.4	397.2	142.8	1.0782	1.3408
86	156.2	141.5	0.03305	0.684	4.059	1.462	255.6	397.6	141.9	1.0805	1.3405
88	160.6	145.9	0.03317	0.663	4.045	1.508	256.9	398.0	141.0	1.0827	1.3403
90	165.0	150.3	0.03329	0.643	4.030	1.555	258.2	398.3	140.1	1.0850	1.3400
92	169.6	154.9	0.03341	0.626	4.015	1.597	259.5	398.7	139.2	1.0873	1.3398
94	174.2	159.5	0.03353	0.609	4.001	1.642	260.8	399.1	138.3	1.0895	1.3395
96	178.9	164.2	0.03366	0.592	3.986	1.689	262.1	399.5	137.4	1.0918	1.3393
98	183.7	169.0	0.03378	0.575	3.972	1.739	263.3	399.9	136.5	1.0940	1.3390
100	188.7	174.0	0.03390	0.558	3.957	1.792	264.6	400.2	135.6	1.0963	1.3388
102	193.8	179.1	0.03402	0.544	3.941	1.838	265.9	400.5	134.6	1.0986	1.3386
104	198.9	184.2	0.03415	0.530	3.925	1.887	267.2	400.9	133.7	1.1010	1.3384
106	204.1	189.4	0.03427	0.516	3.910	1.938	268.5	401.2	132.7	1.1033	1.3382
108	209.3	194.6	0.03439	0.502	3.894	1.992	269.8	401.6	131.8	1.1057	1.3380
110	214.8	200.1	0.03452	0.487	3.878	2.053	271.1	401.9	130.8	1.1080	1.3378
112	220.4	205.7	0.03468	0.475	3.862	2.105	272.5	402.3	129.8	1.1103	1.3376
114	226.0	211.3	0.03484	0.463	3.846	2.160	273.9	402.7	128.8	1.1126	1.3374
116	231.6	216.9	0.03500	0.451	3.830	2.217	275.2	403.0	127.8	1.1149	1.3372
118	237.3	222.6	0.03516	0.439	3.814	2.278	276.6	403.4	126.8	1.1172	1.3370
120	243.4	228.7	0.03532	0.426	3.798	2.347	278.0	403.8	125.8	1.1195	1.3368
122	249.7	235.0	0.03548	0.415	3.780	2.410	279.4	404.1	124.7	1.1218	1.3366
124	255.7	241.0	0.03564	0.404	3.763	2.475	280.9	404.5	123.6	1.1241	1.3363
126	261.7	247.0	0.03580	0.393	3.745	2.544	282.3	404.8	122.5	1.1264	1.3361
128	267.9	253.2	0.03596	0.382	3.728	2.618	283.8	405.2	121.4	1.1287	1.3358
130	274.5	259.8	0.03612	0.370	3.710	2.703	285.2	405.4	120.2	1.1310	1.3356
132	281.1	266.4	0.03630	0.360	3.692	2.778	286.7	405.7	119.0	1.1334	1.3353
134	287.9	273.2	0.03648	0.350	3.674	2.857	288.2	406.1	117.9	1.1358	1.3350
136	294.7	280.0	0.03666	0.340	3.657	2.941	289.7	406.4	116.7	1.1382	1.3348
138	301.4	286.7	0.03684	0.330	3.639	3.030	291.2	406.7	115.5	1.1406	1.3345
140	308.4	293.7	0.03702	0.320	3.621	3.125	292.7	407.0	114.3	1.1430	1.3347
142	315.5	300.8	0.03725	0.312	3.600	3.205	294.2	407.3	113.1	1.1454	1.3339
144	322.8	308.1	0.03748	0.303	3.578	3.300	295.7	407.6	111.9	1.1479	1.3336
146	330.2	315.5	0.03771	0.295	3.557	3.390	297.2	407.8	110.6	1.1503	1.3332
148	337.6	322.9	0.03794	0.286	3.535	3.496	298.6	408.0	109.4	1.1528	1.3329
150	345.4	330.7	0.03817	0.278	3.514	3.597	300.2	408.2	108.0	1.1552	1.3326
152	352.9	338.2	0.03846	0.270	3.487	3.704	301.8	408.4	106.6	1.1578	1.3321
154	360.8	346.1	0.03875	0.263	3.460	3.802	303.4	408.6	105.2	1.1603	1.3317
156	368.6	353.9	0.03904	0.255	3.434	3.922	305.1	408.7	103.6	1.1629	1.3312
158	376.6	361.9	0.03933	0.248	3.407	4.032	306.8	408.8	102.0	1.1654	1.3308
160	385.0	370.3	0.03962	0.240	3.380	4.167	308.4	408.8	100.4	1.1680	1.3303
162	392.9	378.2	0.03996	0.234	3.351	4.273	310.2	408.8	98.6	1.1707	1.3297
164	401.0	386.3	0.04030	0.227	3.322	4.405	312.0	408.9	96.9	1.1734	1.3291
166	409.3	394.6	0.04064	0.221	3.292	4.525	313.9	408.9	95.0	1.1762	1.3284
168	417.8	403.1	0.04098	0.214	3.263	4.673	315.7	408.8	93.1	1.1789	1.3278
170	426.0	411.3	0.04132	0.208	3.234	4.808	317.5	408.6	91.1	1.1816	1.3272
172	436.4	421.7	0.04179	0.202	3.201	4.950	319.5	408.6	89.1	1.1847	1.3262
174	445.9	431.2	0.04226	0.197	3.168	5.076	321.5	408.6	87.1	1.1878	1.3252
176	455.2	440.5	0.04273	0.191	3.136	5.236	323.5	408.4	84.9	1.1908	1.3243
178	464.1	449.4	0.04320	0.186	3.103	5.376	325.5	408.2	82.7	1.1939	1.3233
180	473.2	458.5	0.04367	0.180	3.07	5.556	327.5	407.6	80.1	1.1970	1.3223
182	483.0	468.3	0.04436	0.174	3.03	5.747	329.8	407.4	77.6	1.2004	1.3210
184	492.9	478.2	0.04505	0.168	2.99	5.952	332.2	407.1	74.9	1.2038	1.3196
186	503.1	488.4	0.04574	0.161	2.95	6.211	334.5	406.6	72.1	1.2072	1.3183
188	512.8	498.1	0.04643	0.155	2.91	6.452	336.9	405.9	69.0	1.2106	1.3169
190	523.4	508.7	0.04712	0.149	2.87	6.711	339.2	404.6	65.7	1.2140	1.3156
200	575.0	560.3	0.0521	0.113	2.59	8.850	353.5	398.3	44.8	1.2360	1.3040

Taken from paper by Walter V. Stearns and Emmanuel J. George published in The Petroleum Engineer, Reference Annual, July 1, 1943, after being presented before American Chemical Society, Detroit, Michigan, April 12-16, 1943, and published in Industrial and Engineering Chemistry.

SELF-ALIGNING LINKAGE
An Outstanding Achievement in Controller Construction



Universal-joint-type action of linkage in Foxboro's new M-40 Controller assures straight line motion.



Here's an entirely new conception of mechanical links and pivots. It offers several important advantages – all of which contribute to the greater accuracy, stability, responsiveness and accessibility of Foxboro's M-40 Controller.

The new, high precision ball link operates essentially like a universal joint, requiring no critical alignment of levers to insure free action without binding. Tubular construction gives it unusual rigidity, strength and lightness. New pinch-clip permits instant removal.

Furthermore, this new type of link is made to the extremely close tolerance of ±.0002 . . . another contributing factor towards smoother operation; free from lost motion, dead space, or sticking. It is rugged, and simple to install . . . snapped in or out of place easily, with positive assurance that it will line up properly.

This new exclusive link is one of the outstanding features of the Foxboro M-40 Controller. It helps to make possible the unique *Permaligned* construction which assures outstanding performance from every angle.

To appreciate fully the radical advance in controller construction represented by this new instrument, send for Bulletin 381. It contains a complete but concise description of each M-40 improvement. Write **The Foxboro Company, 130 Neponset Avenue, Foxboro, Mass., U. S. A.** Branches in all principal cities.

FOXBORO
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M-40 CONTROLLER

the only controller with *Permaligned* construction

THERMODYNAMIC PROPERTIES OF PROPANE*

TABLE 2. Properties of superheated propane vapor.

Temp., °F.	P = 15 in. Hg, t = —70.6° F.			P = 10 in. Hg, t = —60° F.			P = 5 in. Hg, t = —51° F.		
	V	H	S	V	H	S	V	H	S
Satd.	12.72	356.5	1.3785	9.80	360.0	1.3740	7.90	362.75	1.3718
—70	12.78	357.0	1.3791	....	....	....	....	....	....
—60	13.11	360.3	1.3869	....	....	....	....	....	....
—50	13.45	363.5	1.3946	10.042	363.2	1.3816	7.978	362.8	1.3720
—40	13.79	366.8	1.4023	10.30	366.5	1.3893	8.182	366.2	1.3796
—30	14.13	370.1	1.4100	10.55	269.8	1.3970	8.387	369.6	1.3872
—20	14.47	373.4	1.4177	10.81	373.1	1.4045	8.591	373.0	1.3948
—10	14.81	376.8	1.4253	11.06	376.6	1.4121	8.796	376.4	1.4024
0	15.14	380.2	1.4329	11.321	380.0	1.4197	9.000	379.9	1.4100
10	15.48	383.8	1.4405	11.57	383.6	1.4273	9.204	383.4	1.4176
20	15.82	387.4	1.4481	11.83	387.2	1.4349	9.409	387.0	1.4252
30	16.16	391.1	1.4557	12.08	390.9	1.4425	9.613	390.7	1.4328
40	16.50	394.8	1.4633	12.34	394.6	1.4501	9.818	394.4	1.4404
50	16.83	398.6	1.4709	12.59	398.4	1.4577	10.02	398.2	1.4480
60	17.17	402.4	1.4785	12.85	402.2	1.4652	10.23	402.0	1.4556
70	17.51	406.3	1.4861	13.10	406.1	1.4727	10.43	406.0	1.4630
80	17.85	410.2	1.4937	13.36	410.0	1.4802	10.64	410.0	1.4706
90	18.19	414.3	1.5013	13.61	414.1	1.4877	10.84	414.0	1.4780
100	18.52	418.4	1.5088	13.87	418.2	1.4952	11.050	418.1	1.4864
110	18.86	422.5	1.5162	14.12	422.3	1.5026	11.25	422.1	1.4928
120	19.20	426.6	1.5235	14.38	426.4	1.5101	11.45	426.2	1.5002
130	19.54	430.8	1.5308	14.63	430.6	1.5174	11.66	430.6	1.5075
140	19.88	435.2	1.5380	14.89	435.0	1.5245	11.86	435.9	1.5148
150	20.21	439.6	1.5452	15.14	439.4	1.5317	12.07	439.3	1.5221
160	20.55	444.1	1.5524	15.40	443.9	1.5389	12.27	443.8	1.5293
170	20.89	448.6	1.5596	15.65	448.4	1.5461	12.47	448.4	1.5365
180	21.23	453.1	1.5668	15.91	452.9	1.5533	12.68	452.9	1.5437
190	21.57	457.9	1.5740	16.16	457.7	1.5605	12.88	457.6	1.5509
200	21.90	462.5	1.5812	16.42	462.4	1.5677	13.09	462.4	1.5581
	P = 14.696 lb. abs., t = —43.708° F.			P = 16 lb. abs., t = —40.01° F.			P = 20 lb. abs., t = —30.30° F.		
Satd.	6.66	364.6	1.3681	6.195	365.5	1.3670	5.050	368.4	1.3640
—40	6.775	365.8	1.3710	6.212	365.6	1.3671	....	....	....
—30	6.949	369.3	1.3788	6.371	369.2	1.3784	5.060	368.6	1.3642
—20	7.123	372.8	1.3866	6.530	372.6	1.3825	5.186	372.2	1.3719
—10	7.297	376.3	1.3943	6.659	376.1	1.3902	5.313	375.8	1.3796
0	7.471	379.8	1.4020	6.848	379.6	1.3979	5.439	739.3	1.3873
10	7.644	383.3	1.4096	7.007	383.2	1.4056	5.567	382.9	1.3949
20	7.816	386.8	1.4772	7.166	386.8	1.4132	5.695	286.5	1.4025
30	7.988	390.6	1.4248	7.324	390.4	1.4208	5.823	390.2	1.4101
40	8.160	394.3	1.4324	7.482	394.2	1.4284	5.951	393.9	1.4177
50	8.332	398.1	1.4399	7.640	398.0	1.4359	6.079	397.7	1.4252
60	8.503	401.9	1.4474	7.798	401.8	1.4434	6.207	401.6	1.4327
70	8.674	405.8	1.4549	7.955	405.8	1.4508	6.334	405.5	1.4402
80	8.844	409.8	1.4623	8.112	409.8	1.4582	6.461	409.4	1.4477
90	9.016	413.9	1.4698	8.269	413.8	1.4656	6.588	413.5	1.4551
100	9.187	418.0	1.4772	8.426	417.9	1.4730	6.716	417.6	1.4625
110	9.358	422.1	1.4845	8.583	421.9	1.4804	6.843	421.7	1.4698
120	9.528	426.2	1.4918	8.740	426.1	1.4878	6.969	425.9	1.4771
130	9.699	430.4	1.4991	8.897	430.4	1.4952	7.095	430.2	1.4844
140	9.869	434.8	1.5064	9.054	434.8	1.5026	7.221	434.6	1.4917
150	10.040	439.2	1.5137	9.211	439.2	1.5099	7.347	439.0	1.4990
160	10.21	443.7	1.5210	9.368	443.7	1.5172	7.473	443.5	1.5063
170	10.38	448.3	1.5283	9.525	448.2	1.5245	7.599	448.0	1.5136
180	10.51	452.9	1.5256	9.682	452.8	1.5317	7.725	452.6	1.5209
190	10.72	457.5	1.5428	9.839	457.4	1.5389	7.851	457.3	1.5282
200	10.84	462.4	1.5500	9.996	462.2	1.5460	7.977	461.9	1.5355
	P = 24 lb. abs., t = —21.97° F.			P = 30 lb. abs., t = —11.52° F.			P = 40 lb. abs., t = +2.90° F.		
Satd.	4.25	370.9	1.3615	3.30	374.00	1.3588	2.61	382.2	1.3548
—20	4.279	371.7	1.3632	....	....	....	....	....	....
—10	4.390	375.3	1.3712	3.47	374.6	1.3597	....	....	....
0	4.499	378.9	1.3790	3.559	378.3	1.3678	....	....	....
10	4.608	382.5	1.3806	3.647	382.0	1.3754	2.684	380.9	1.3603
20	4.716	386.2	1.3942	3.735	385.7	1.3830	2.753	384.7	1.3684
30	4.824	389.9	1.4018	3.823	389.4	1.3905	2.821	388.5	1.3761
40	4.932	393.6	1.4094	3.911	393.1	1.3980	2.889	392.2	1.3838
50	5.040	397.4	1.4170	3.999	396.9	1.4055	2.957	396.1	1.3914
60	5.147	401.3	1.4245	4.087	400.8	1.4130	3.025	400.0	1.3990
70	5.254	405.2	1.4320	4.174	404.7	1.4205	3.092	404.0	1.4065
80	5.361	409.2	1.4394	4.261	408.7	1.4280	3.159	408.0	1.4140
90	5.467	413.3	1.4468	4.347	412.8	1.4354	3.224	412.1	1.4215
100	5.573	417.4	1.4542	4.432	417.0	1.4428	3.289	416.2	1.4290
110	5.679	421.5	1.4616	4.517	421.2	1.4502	3.354	420.4	1.4365
120	5.785	425.6	1.4690	4.602	425.4	1.4576	3.419	424.6	1.4440
130	5.891	429.8	1.4764	4.687	429.6	1.4650	3.484	429.0	1.4514
140	5.997	434.3	1.4837	4.772	434.0	1.4724	3.549	433.4	1.4588
150	6.103	438.8	1.4910	4.857	438.4	1.4898	3.614	437.9	1.4662
160	6.209	443.3	1.4983	4.942	443.0	1.4872	3.679	442.5	1.4736
170	6.315	447.9	1.5056	5.027	447.6	1.4946	3.744	447.1	1.4810
180	6.420	452.5	1.5128	5.112	452.2	1.5020	3.809	451.8	1.4884
190	6.525	457.1	1.5200	5.197	456.9	1.5094	3.874	456.5	1.4957
200	6.630	462.0	1.5272	5.282	461.8	1.5168	3.939	461.3	1.5030

(Continued on Sheet 5)

Taken from paper by Walter V. Stearns and Emmanuel J. George published in The Petroleum Engineer, Reference Annual, July 1, 1943, after being presented before American Chemical Society, Detroit, Michigan, April 12-16, 1943, and published in Industrial and Engineering Chemistry.

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

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THERMODYNAMIC PROPERTIES OF PROPANE*

TAPLE 2. Properties* of superheated propane vapor *(Concluded)*

Temp. °F.	P=50 lb. abs., t=14.7° F. V	H	S	P=60 lb. abs., t=24.80° F. V	H	S	P=80 lb. abs., t=41.69° F. V	H	S
Satd.	2.115	381.2	1.3521	1.76	383.8	1.3501	1.32	387.8	1.3470
20	2.159	383.5	1.3562	....	....	....	....	....	....
30	2.217	387.4	1.3647	1.814	386.1	1.3547	....	....	....
40	2.275	391.3	1.3726	1.863	390.1	1.3630	....	....	....
50	2.331	395.2	1.3804	1.911	394.1	1.3710	1.36	391.9	1.3540
60	2.386	399.1	1.3881	1.959	398.2	1.3789	1.424	396.1	1.3624
70	2.441	403.1	1.3957	2.006	402.2	1.3808	1.462	400.3	1.3707
80	2.495	407.1	1.4033	2.053	406.3	1.3948	1.500	404.6	1.3785
90	2.549	411.2	1.4109	2.099	410.5	1.4025	1.537	408.9	1.3863
100	2.602	415.4	1.4185	2.145	414.8	1.4102	1.573	413.2	1.3940
110	2.656	419.6	1.4261	2.190	419.0	1.4179	1.609	417.5	1.4017
120	2.709	423.9	1.4337	2.235	423.4	1.4254	1.644	421.8	1.4094
130	2.762	428.3	1.4412	2.280	427.8	1.4330	1.679	426.3	1.4171
140	2.815	432.8	1.4487	2.325	432.2	1.4404	1.714	430.9	1.4248
150	2.868	437.3	1.4562	2.370	436.8	1.4479	1.749	435.6	1.4325
160	2.921	441.9	1.4637	2.415	441.4	1.4554	1.784	440.3	1.4402
170	2.975	446.6	1.4711	2.460	446.1	1.4629	1.818	445.0	1.4478
180	3.027	451.3	1.4785	2.505	450.8	1.4703	1.852	449.8	1.4554
190	3.079	456.1	1.4859	2.549	455.6	1.4777	1.886	454.7	1.4629
200	3.131	460.9	1.4933	2.593	460.5	1.4851	1.920	459.7	1.4704
	P=100 lb. abs., t=55.62° F.			P=130 lb. abs., t=73.20° F.			P=160 lb. abs., t=87.71° F.		
Satd.	1.06	391.2	1.3448	0.8165	395.0	1.3424	0.6685	397.9	1.3404
60	1.094	393.5	1.3488	....	....	....	....	....	....
70	1.131	398.3	1.3573	....	....	....	....	....	....
80	1.164	402.6	1.3656	0.8456	398.8	1.3486	....	....	....
90	1.196	406.9	1.3735	0.8762	403.6	1.3571	0.6695	399.2	1.3423
100	1.227	411.4	1.3816	0.9045	408.3	1.3659	0.6969	404.7	1.3521
110	1.258	415.7	1.3893	0.9315	412.9	1.3740	0.7222	409.6	1.3610
120	1.289	420.3	1.3962	0.9588	417.8	1.3822	0.7464	414.6	1.3698
130	1.318	424.9	1.4050	0.9815	422.5	1.3903	0.7691	419.7	1.3784
140	1.347	429.6	1.4130	1.006	427.3	1.3987	0.7908	424.8	1.3867
150	1.375	434.4	1.4209	1.029	432.2	1.4059	0.8118	429.9	1.3949
160	1.400	439.1	1.4286	1.052	437.1	1.4150	0.8319	434.9	1.4031
170	1.432	444.0	1.4362	1.076	442.1	1.4230	0.8520	440.0	1.4113
180	1.460	448.8	1.4440	1.098	447.0	1.4310	0.8712	445.1	1.4195
190	1.488	453.8	1.4518	1.120	452.0	1.4389	0.8903	450.3	1.4276
200	1.516	458.8	1.4598	1.143	457.1	1.4468	0.9093	455.4	1.4357
	P=190 lb. abs., t=100.50° F.			P=220 lb. abs., t=111.85° F.			P=250 lb. abs., t=122.12° F.		
Satd.	0.5540	400.4	1.3388	0.4738	402.5	1.3375	0.4130	404.2	1.3355
110	0.5774	405.9	1.3485	....	....	....	....	....	....
120	0.5995	411.6	1.3580	0.4911	407.7	1.3460	....	....	....
130	0.6208	417.0	1.3670	0.5121	413.7	1.3558	0.4283	409.7	1.3450
140	0.6415	422.1	1.3759	0.5314	419.2	1.3650	0.4473	415.9	1.3550
150	0.6607	427.3	1.3844	0.5498	424.5	1.3739	0.4649	421.4	1.3640
160	1.6792	432.4	1.3930	0.5673	429.8	1.3827	0.4816	427.1	1.3732
170	0.6971	437.8	1.4013	0.5846	435.3	1.3913	0.4972	432.6	1.3819
180	0.7144	443.0	1.4096	0.5998	440.6	1.3999	0.5121	438.0	1.3908
190	0.7311	448.2	1.4176	0.6149	445.9	1.4080	0.5266	443.5	1.3990
200	0.7472	453.4	1.4255	0.6302	451.2	1.4161	0.5408	448.9	1.4074
	P=300 lb. abs., t=137.55° F.								
Satd.	0.3332	406.6	1.3345						
140	0.3392	408.7	1.3372						
150	0.3579	415.6	1.3480						
160	0.3745	422.0	1.3580						
170	0.3896	427.8	1.3674						
180	0.4037	433.2	1.3765						
190	0.4171	439.2	1.3855						
200	0.4303	444.9	1.3944						

*Pressures below atmospheric are expressed in inches of Hg vacuum pressures; above atmospheric, in pounds per square inch absolute.

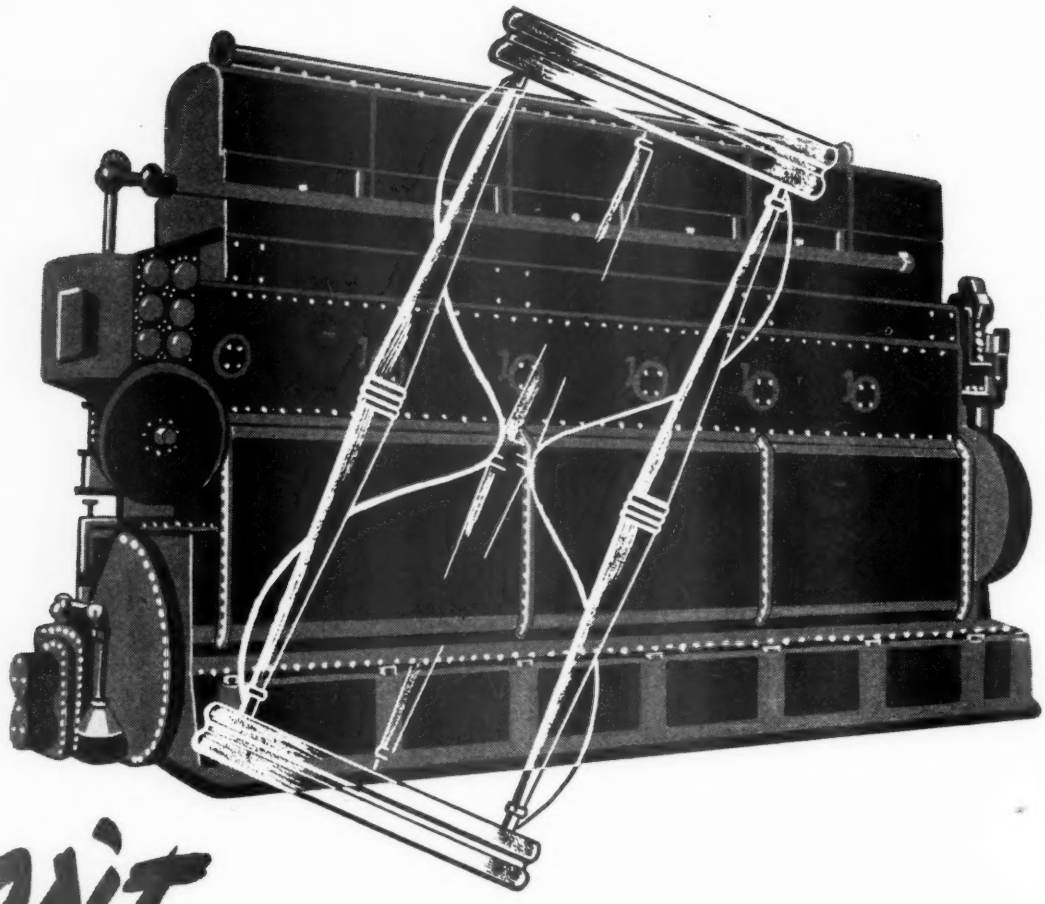
Notes: The second part of Table II (above) contains some corrected values for H, in accordance with a personal communication from Emmanuel George to *The Petroleum Engineer* on September 24, 1946.

2. In Table II., V = volume, cu. ft. per lb.; H = absolute heat content (enthalpy), B.T.U./lb.; S = absolute entropy, B.T.U./lb./°F., and J is taken as 0.18511.

3. The temperature and pressure conditions of the saturated propane vapor prior to superheating are underlined above each group of figures.

Example: Saturated propane vapor taken at 100 lb. per sq. in., absolute and 55.62°F. is superheated to 200° F. What is the change in volume, enthalpy, and entropy? Table II (above) shows that the volume changes from 1.06 cu. ft. per lb. to 1.516 cu. ft. per lb.; enthalpy changes from 391.2 to 458.8 B.T.U./lb., a gain of 67.6 B.T.U./lb.; and entropy changes from 1.3448 to 1.4598 B.T.U./lb./°F.

*Taken from paper by Walter V. Stearns and Emmanuel J. George published in The Petroleum Engineer, Reference Annual, July 1, 1943, after being presented before American Chemical Society, Detroit, Michigan, April 12-16, 1943, and published in Industrial and Engineering Chemistry.



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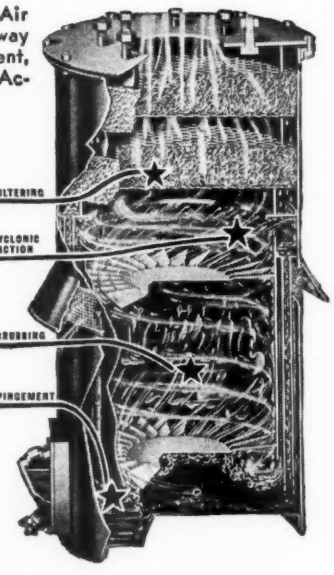
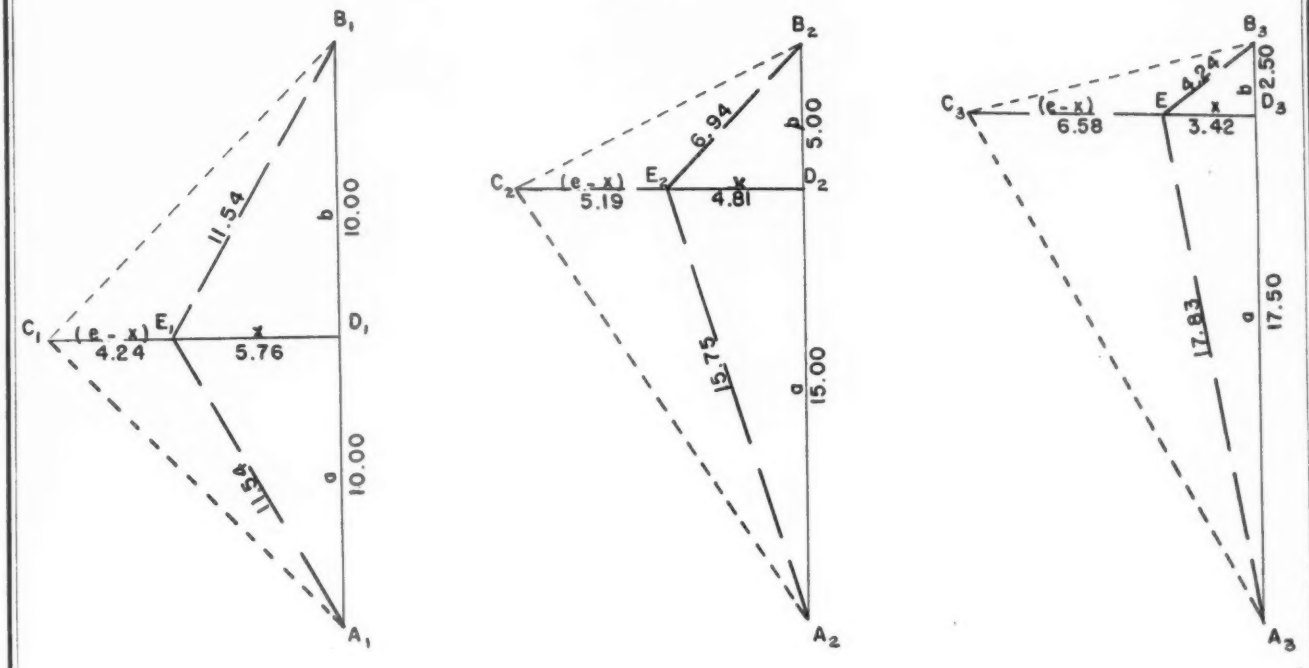


AAF Cycoil OIL BATH AIR CLEANER AND INTAKE SILENCER

ECONOMICAL ALIGNMENTS FOR PIPE LINES*

FIG. 1.



*This chart and formulas are taken from an article with the above title by Peyton Bryan, Assistant Division Engineer, Humble Pipe Line Company, that was published in the October 1946, issue of *The Petroleum Engineer*, p. 212.

Fig. 1 illustrates three pipe-line extension problems with the pipe line to be extended from the terminus A to the other two points, C & B, with the least quantity of pipe.

(1) The solution of each problem is the route A-E-B, according to the formula:

$$x = \frac{\sqrt{(a^2+x^2)(b^2+x^2)}}{\sqrt{a^2+x^2}+\sqrt{b^2+x^2}} \quad \text{. . equation (1)}$$

The equation is readily solved by trial.

Example:

Substituting the distances of the second triangle of Fig. 1 in equation (1):

$$x = \frac{\sqrt{(225+x^2)(25+x^2)}}{\sqrt{225+x^2}+\sqrt{25+x^2}}$$

Try $x = 6$

$$x = 6 = \frac{126.177}{23.966}$$

The value of the function is too small for the assumed value of x. Decreasing the value of x increases the value of the function. Try $x = 4$.

$$x = 4 = \frac{99.403}{21.927}$$

The function is now too large for the assumed value of x. Remembering that the value of the function varies (relatively) inversely as the value of x, a few more trials gives 4.81 as a good value for x. The total length of pipe required is:

$$Q = (10 - 4.81) + 15.75 + 6.94 = 27.88$$

Had the lines been laid, the usual case, on "A - B" and "C - D" the length of pipe required would have been 30. Assuming the pipe to be 6 in., at $8000 per mile, equation (1) would produce a saving of 2.12 miles, or $16,960.

The solution of equation (1) for the other two triangles gives the results shown in Fig. 1.

(2) The solution for cases where a larger diameter pipe is required between A and B than for the branch C-E, the following formula can be used where M = the unit cost of the line A-E-B, and N = the unit cost of the branch C-E:

$$x = \frac{\sqrt{(a^2+x^2)(b^2+x^2)}}{M/N(\sqrt{a^2+x^2}+\sqrt{b^2+x^2}} \quad \text{equation (2)}$$

Example:

For instance, if 6-in. pipe at $8000 per mile is required for "A - E - B," and 4-in. at $4800 per mile can be used for "C - E," then, in the second triangle of Fig. 1:

$$x = \frac{\sqrt{(225+x^2)(25+x^2)}}{8.0/4.8(\sqrt{225+x^2}+\sqrt{25+x^2})}$$

The value of x for this case is 2.89, giving 7.11 miles of 4 in. from "C" to "E," and 21.05 miles of 6 in. for the line "A - E - B." The investment for the alignment of equation (2) would be $202,528 as against $208,000 for the usual direct line from "A" to "B" with a perpendicular branch to "C."

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Running Tour WITH MEN IN THE INDUSTRY

• **C. Henry Hathaway,** assistant ot the president of the Gulf Oil Corporation, Pittsburgh, died at Bronxville, New York, on October 7 after a short illness. He was 61 years old. Hathaway was associated with the Gulf Oil Corporation as assistant to the president from October, 1932, until his death. Previously, from 1929 to 1933, he was an assemblyman at Albany from Westchester County, New York.

• **A. J. "Al" Rosenlieb** has been promoted to division manager of The Ohio Oil Company's Illinois division with headquarters in Marshall, Illinois. Rosenlieb succeeds the late **Clarence C. Carroll** who was stricken with a heart attack on September 29. Announcement of Rosenlieb's promotion was made by **W. B. Emery,** vice president and manager of production for The Ohio Oil Company, general offices, Findlay, Ohio.

• **Henry Chalfant,** descendant of one of the founders of Spang-Chalfant and Company, now a division of The National Supply Company, was elected a director of the company at a meeting of the board. He will fill the vacancy recently created by the retirement of **P. J. Shouvlin.** Chalfant is assistant secretary of The National Supply Company. During the war he was in the African and European campaigns as a lieutenant colonel in the Army Air Forces.

Henry Chalfant

• **F. I. L. Lawrence,** director of research and development of Kendall Refining Company, Bradford, Pennsylvania, has been appointed a member of the American Petroleum Institute Committee on Analytical Research.

• **Eben Griffiths** has retired as manager of the advertising and sales promotion department of Socony-Vacuum Oil Company, Inc. **Paul Gosman** succeeds him.

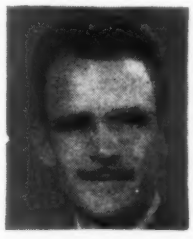
• **J. K. Roberts,** general manager of research for the Standard Oil Company (Indiana), has announced the promotiton of **P. C. White** to the position of chief chemist, Whiting, Indiana, refinery, to fill the position left vacant by the retirement of **F. M. Rogers.** Dr. White joined the Indiana company after receiving his Ph.D. from the University of Chicago in 1938. He became assistant chief chemist in 1945.

R. F. Marschner has been made section leader in charge of exploratory research on petroleum processes. Dr. Marschner received his bachelor's degree from Brown University and his Ph.D. from Penn State. He has been with the company since 1934.

Other members of the research staff have been promoted to the following positons: **J. C. Baili,** acting assistant chief chemist; **W. J. Tancig,** group leader in charge of analytical methods application; **A. P. Lien,** group leader in exploratory research; **J. J. Lukes,** group leader in the pilot plant section, and **H. S. Wood,** group leader in the light oils section of the technical service division.

• **Otto Hammer,** president and **Ken Swart,** chief engineer, of Security Engineering Company, Inc., recently returned to headquarters from a business trip to the

Otto Hammer



Ken Swart

Security branch offices and distributing centers in West Texas, Colorado, and Wyoming. The trip included visits to the operating companies drilling projects where firsthand information on the problems and needs of the operators was obtained.

• **Dr. William L. Russell,** research geologist for the Stanolind Oil and Gas Company, Tulsa, Oklahoma, has been added to the teaching staff of the Texas A. & M. College geology department, according to **Prof. S. A. Lynch,** head of the department. Dr. Russell, widely known for his work in the interpretation of radioactivity and related problems, has been associated with nearly every phase of industrial geological research, and has been associated with numerous concerns in the petroleum industry. Born in New Haven, Connecticut, Dr. Russell received his B. A., M. S., and Ph. D. degrees from Yale University, completing his work there in 1927. Previous teaching experience includes an assistant professorship of geology at the University of South Dakota.

• **F. Ellis Johnson,** former dean ot the colleges of engineering at both the University of Missouri and the University of Wisconsin, will be in charge of educational activities at the Hanford Engineer Works at Richland, Washington, it is announced by William H. Milton, Jr., administrator for that plant and assistant general manager of the General Electric Chemical Department.

• **Robert Gottschalk** has joined Standard Oil Company (Indiana) as assistant manager of the development and patent department. For the last 12 years he has been patent counsel for another company in Chicago and has served with two New York City patent law firms.

• **J. E. (Jesse) Hickman** has been assigned by Byron Jackson Company to its New York Export office in the Graybar Building. Hickman started in the oil industry at Forked Island, Louisiana, in 1936 while still in high school. After graduating from high school, he was with American Chain and Cable Company until 1939 when he joined Byron Jackson Company in Houston. He was in the assembly department for BJ Elliott core drill and had advanced to the shipping department when he joined the Navy in December of 1941. Hickman served in the Atlantic, Caribbean, Mediterranean, Pacific, and South China Seas before his discharge. Upon discharge, he spent several months acquiring the latest information and training in the plants and field services of BJ, Patterson-Ballagh, and International Cementers. Hickman is now assisting B. A. Hilliard in the BJ export office in New York.

J. E. Hickman

• **Clarence Johnson,** for 18 years research engineer at Bailey Meter Company, has established himself as a research consultant on inventions and engineering developments. His headquarters are at Beloit, Wisconsin.

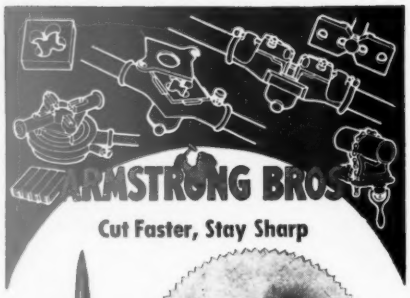
• **Bert Persin Newton,** vice president of Gulf Oil Corporation in charge of foreign marketing, has had the Order of the Lion of Finland, with the rank of Commander, conferred upon him. The honor, the highest which Finland awards to civilians, was conferred by the Finnish Minister to Sweden in recognition of services rendered by Newton to his country. **Col. J. Frank Drake,** president of Gulf, witnessed the ceremony, which took place at the Finnish legation in in Stockholm.

• **Victor A. Indig,** factory export representative for Patterson-Ballagh, Lane-Wells, Overstrom, and Commercial Iron Works, recently visited with his principals in the Los Angeles Basin. Vic has a wide circle of friends and is well known in the California oil fraternity. For many years he was employed by Standard Oil of California in purchasing department. Subsequently he took over the responsibility of purchasing agent for the Kettleman North Dome Association. For three years during World War II, the Navy Department at Washington, D. C., used his procurement experience to good advantage. He creditably handled many important assignments and received a Citation from James Forrestal, Secretary of the Navy. Vic is in the Russ Building, San Francisco.

Victor A. Indig

• **Oscar Lasse** has been appointed manager of the personnel department of The Texas Company, succeeding the late **Charles O. Strahley.** He has been with the company for 30 years, and has been associated with Texaco's personnel department since 1929.

• **Robert D. Walker,** Dallas, Texas, recently discharged as a captaip from the Air Force, has become associated with Oilfield-Industrial Export, Inc., at 30 Rockefeller Plaza, New York. Walker left New York on September 16 for an extensive trip through the oil fields of South America and the West Indies on behalf of his company after spending some time in the plants of this company's principals, Lee C. Moore and Company, Inc., and the Guiberson Corporation. Prior to joining the armed services Walker was active in the oil fields of the southwestern United States for ten years. Upon his return from South America Walker will be permanently located in New York.



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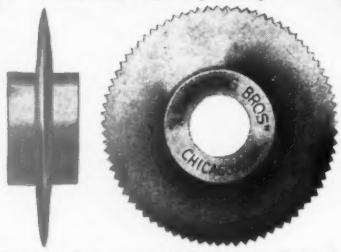

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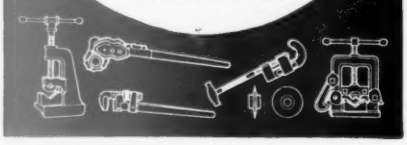

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HOUSTON, TEXAS . . . NEW ORLEANS, LA.

• **George M. Cunningham** is general manager of the new exploration department of Standard of California. **O. J. Haynes** is assistant general manager. The department is to handle Standard's land and lease, geological and exploration activities, with the exception of exploratory drilling.

George M. Cunningham

O. J. Haynes

Appointments to new positions in the department include **W. P. Winham,** superintendent of exploration, southern district; **G. L. Knox,** superintendent of exploration, northern district; **A. J. Solari,** superintendent of exploration, Bay district, and **W. F. Barbat,** assistant chief geologist.

Exploration department staff members who will continue with their former titles are **W. S. W. Kew,** chief geologist; **S. H. Gester,** assistant chief geologist; **C. C. Gester,** consulting geologist; **Phil Gaby,** consulting geophysicist; **G. F. Schroeder,** manager, land and lease division, and **L. H. Hines,** assistant manager, land and lease division.

• **R. H. Rodolf,** manager, pump and compressor division, Gardner-Denver Company, Quincy, Illinois, made a business trip through the Mid-Continent area during October.

• **Ben Hurlbutt** and **Frank Herring** have formed Ben-Franklin Exploration, Inc., 805 Petroleum Building, Wichita, Kansas, specializing in core drill exploration.

• **Chester F. Barnes** has entered private practice as a consultant in geology and geophysics, making his headquarters in Big Spring, Texas. He formerly was with Humble Oil and Refining Company and Cosden Petroleum Corporation.

• **Lawrence K. Marshall** has been elected president of the Cooney Mining Club, student chapter AIME of the New Mexico School of Mines, Socorro. **Arthur S. Lees** is vice president, **H. F. Mullen,** secretary-treasurer, and **Jack I. Laudermilk,** head of the Department of Petroleum Engineering, is faculty sponsor.

• **W. H. Wildes,** president of Republic Natural Gas Company, announces that **Dr. Byron B. Boatright** has been elected a vice president of the company, and will be in charge of the newly created engineering and research department with headquarters in Dallas, Texas. For the last ten years Dr. Boatright has been an independent consulting engineer, and was formerly a member of the firm of Boatright and Mitchell in Houston, Texas.

• **Fenton Ham** is now a partner in The James C. Foss Company, consulting geologists, petroleum and civil engineers, at the County First National Bank Building, Santa Cruz, California. He was formerly with The Superior Oil Company as petroleum engineer.

• **R. R. Griffin,** formerly vice president of the Shell Oil Company, Inc., New York, in charge of marine transportation, died October 22 at Oakland, California, after a long illness. Griffin retired from his post with Shell on August 1 of this year after 25 years' service with the company.

• **C. V. Lane** has been appointed manager of Standard of California's purchase and stores department. He succeeds **L. B. Waters,** who was granted an indefinite leave of absence because of poor health. At the same time **A. R. Eimer** became an assistant manager succeeding Lane. Lane was assistant manager for Standard's purchase and stores department at the time of his present appointment. Waters has been with Standard since 1922 and served as manager of the purchase and stores department for the last six years.

• **Frank J. Hearty,** former president of F. J. Hearty and Company, Los Angeles and San Francisco, and veteran west coast representative of Edward Valves, Inc., died November 3 after a short illness. Hearty headed the firm that represented Edward in the west for more than 25 years. He served as an engineering officer in the U. S. Navy in both the Spanish-American and first World War, and spent 12 years in power plant design and construction before becoming associated with Edward Valves.

He has been succeeded as head of F. J. Hearty and Company by **Paul E. Bradfield** who has been manager of the Los Angeles office for some time.

• **Monroe Rooks,** former motor truck branch manager at New Orleans for International Harvester Company, has been transferred to the Birmingham general line branch in the same capacity. Rooks will replace **P. H. Baker,** former manager at Birmingham, who will establish his own dealership at Macon, Georgia, handling International Harvester equipment.

• **W. A. Heath** has resigned from Phillips Petroleum Company to join Earlougher Engineering, Tulsa, Oklahoma, petroleum consultants specializing in water flooding and pressure maintenance by water injection. Heath graduated from the University of Pittsburgh in 1929 with a B.S. in petroleum engineering and obtained his early experience in secondary recovery in Pennsylvania. In 1936 he went with Phillips Petroleum Company at Bartlesville where he was active in development of their water flooding operations in northeastern Oklahoma and eastern Kansas. He was made assistant division superintendent in 1938, and since 1940 has been the secondary recovery engineer in the Bartlesville office.

• **W. R. Everett, Jr.,** has been appointed store manager of the Wichita Falls, Texas, branch by Continental Supply Company. Everett succeeds **H. H. Waters,** who has resigned.

Dr. C. C. Crawford

• **Frank Phillips,** chairman, and **K. S. Adams,** president, of Phillips Petroleum Company, announce the appointment of **Dr. C. C. Crawford** as assistant manager of the chemical products department in charge of the special products, product development, and Perco divisions. **Dr. A. J. Dirksen** was promoted to manager of the products development division, the position formerly held by Crawford.

• **Helmer Peterson** has been made factory manager of Mack-International Motor Truck Corporation's Long Island City, New York, plant. The announcement was made by **A. N. Morton,** vice president. In his new capacity Peterson will oversee the manufacture of Mack fire apparatus, as well as the fabricatoin of replacement parts for obsolete models of the entire Mack line.

• **Dr. Enrique Gonzales-Navas,** Consul General of Venezuela in New York, recently bestowed on **Thomas W. Palmer,** head of the Latin-American legal staff of Standard Oil Company (New Jersey), the highest honor his country gives a foreigner. Palmer received the Order of the Liberator with rank of commander and a citation for his contribution in promoting better relations between Venezuela and the United States. The decoration was originally granted July 10, 1945, by President Isaias Medina of Venezuela and recently reapproved by his successor, Romulo Betancourt.

As head of Jersey Standard's Latin-American legal activities, Palmer has spent many years in South American countries and taken an active part in fostering understanding among the Americas.

• **P. V. Galvin** has announced the appointment of **Paul K. Povlsen** to the position of assistant to the president of the Galvin Manufacturing Corporation of Chicago. Povlsen was formerly vice president in charge of production and engineering for the J. I. Case Company of Racine, Wisconsin. He holds a degree from Columbia University in engineering and arts and was with the New York Telephone Company and the New Jersey Bell Telephone Company for 16 years.

Paul K. Povlsen

• **Lawrence L. Jones** has been made superintendent of General Electric's new factory for the manufacture of Glyptal alkyd resins at Anaheim, California, it is announced by Harry K. Collins, manager of GE's Resin and Insulation Division, Schenectady, New York.

• **James Courtney,** West Texas superintendent for Snowden Oil and Gas Company, Dallas, has established offices in the Dunagar Building, Midland, Texas.

• **T. E. "Ed" Wilde** has been appointed to the technical service and process development staff of Griffin Chemical Company, San Francisco. For the last 15 years, Wilde has acted in various capacities for technical departments of the Union Oil Company, most recently as assistant to the manager of the chemical products division in Los Angeles. He also served in the manufacturing department at Union Oil and at one time was head of that company's control laboratory at Oleum.

• **R. G. Greene** has been appointed manager of lands and leases by Union Oil Company. He replaces **John L. Church,** who has been appointed assistant to **A. C. Rubel,** vice president, on special assignment. A graduate of Stanford University, class of 1923, Greene began his association with the company in 1925 as a geologist. His first assignment was in Venezuela where he remained until returning to California in 1929. Seven years later, he severed his connection with the company to head up the Union Pacific Railroad's geological department. Since his return to Union Oil in November of last year, he has organized and established the company's northwest land division in Seattle.

• **Phillip E. Sharr** has been made superintendent of the Pittsburgh Plate Glass Company's alkali producing plant at Bartlett, California, it is announced by **E. T. Asplundh,** vice president in charge of the firm's Columbia Chemical Division. The new superintendent has served as chief engineer at the west coast plant for the past year.

GAUGING . . . . PRODUCTION at the well

CUTS PRODUCTION COSTS

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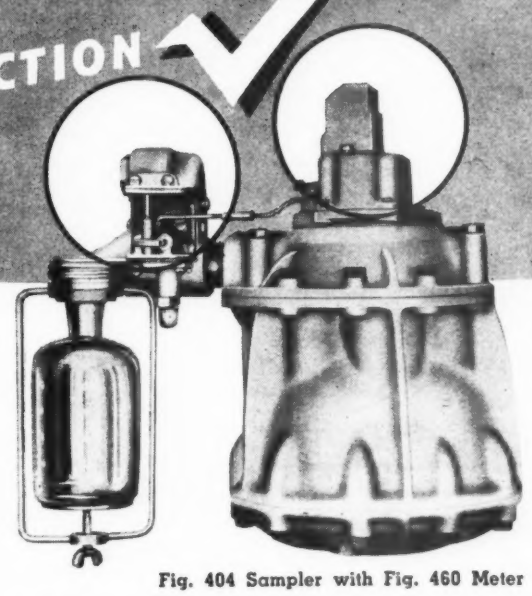

Fig. 404 Sampler with Fig. 460 Meter

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The Fig. 404 Automatic Sampler makes it easy to evaluate the QUALITY of each well's output by furnishing a true proportional sample.

This is the only efficient, economical basis for payment of royalties and taxes, analyses of control and operating expense, and quick, unfailing detection of sleepers or wet wells.

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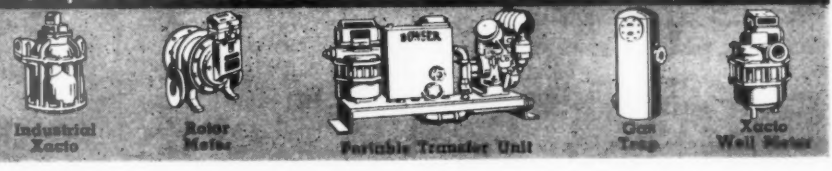
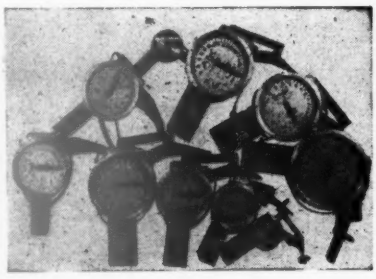


LINE SCALES



10 of the 20 Models we manufacture. 40,000 pounds to 500,000 pounds. A special scale for any job.

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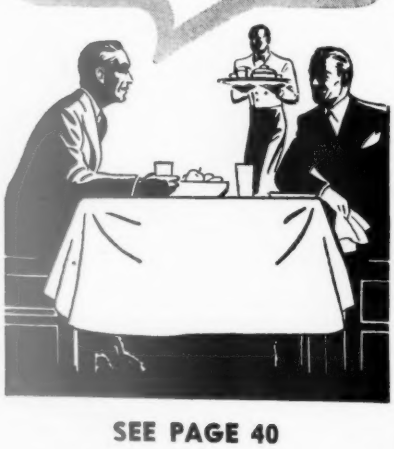
THAT "COMPLETE PACKAGE" REFINERY INTERESTS ME!



SEE PAGE 40

LAUGH WITH BARNEY

Just how serious a lady's injuries were in an accident which occurred recently, it is hard to tell because the paper spoke thusly of the mishap: "Mrs. Wilson, in attempting to get out of the auto, fell to the pavement, injuring her somewhat."

"Oh," said Maizie, gushingly, "I had the most gorgeous time last night! I met a new man and he invited me to a wonderful dinner at his apartment. After dinner, he showed me a dozen mink coats and asked me to choose one for myself."

"How perfectly adorable," gurgled Myrtle, "and what did you have to do?"

"Just shorten the sleeves," said Maizie.

"I represent the Mountain Wool Company, Mam, would you be interested in some coarse yarns?"

"Gosh, yes—tell me a couple."

Barber: Was your tie red when you came in?

Customer: No, it wasn't.

Barber: Gosh!

A newly created papa received the glad tidings in a telegram: "Hazel gave birth to a little girl this morning; both doing well.

On the message was a sticker reading: "When you want a boy call Western Union."

On an Army bulletin board was posted this sign: "Court-martial docket completely jammed. Any soldier desirous of violating the Articles of War will please postpone action for ten days."

A teacher, unfastening with difficulty the coat of one of her little pupils, asked, "Did your mother hook this coat for you?"

"No," was the reply, "she bought it."

Doctor to patient (after completing examination): You go back to your boss and tell him his diagnosis was wrong. I am unable to find any lead.

"How many sexes are there, Oliver?" asked the teacher.

"I can only think of three, teacher," he said.

"Three?" she queried.

He replied, "Men, women and insects."

A grave digger, absorbed in his thoughts, dug the grave so deep he couldn't see out. Came nightfall and the evening chill, his predicament became more and more uncomfortable. He shouted for help, and at last attracted the attention of a drunk.

"Get me out of here," he shouted. "I'm cold."

The drunk looked into the grave and finally distinguished the form of the uncomfortable grave digger.

"S'sno wonder you're cold," he said. "You haven't any dirt on you."

After considerable search, a little boy and girl located a knothole in the high board fence surrounding a nudist colony.

"Gee, look at the people!" exclaimed the lad.

"Are they men or women?"

"Can't tell. They don't have any clothes on."

Wallflower: A girl who wears a sweater to keep warm.

Father (looking cautiously into the club room of a fraternity house): Does Bill White live here?

Voice from inside: Yeah—just bring him in and lay him on the couch.

A man has less courage than a woman. Imagine a man with seven cents in his pockets trying on ten different suits.

Zeke is a whimsical colored man who does light hauling in a dilapidated old wagon drawn by a gigantic mule of venerable age, profound deliberation and undaunted won't-power.

"Tell me, Zeke," said the patron, "what do you call that old mule?"

"Public Service Corporation," replied Zeke.

"What on earth made you give him such a name as that?"

"Wal, suh," explained Zeke, "jes' because dat am de nachel name o' a mule like him. Dat mule kin stan' mo' abuse an' go right on habbin' his own way dan any pusson yo' eber see."

Wife (about skunk coat she just received from husband): I don't see how such a nice coat came from such a foul beast.

Hubby: Look, I don't mind not being thanked, but I think you're going a little too far!

A Sunday School teacher was showing her class a picture of the Christian martyrs in a den of lions. One little boy seemed very sad about it.

"Gee," he exclaimed, "look at that poor lion away in the back. He won't get any!"

Office Boy: Are you a salesman, bill collector or a friend of the boss?

Caller: All three.

Office Boy: Well, then, he's at a conference; he's out of town; step in and see him.

"Madam, where did you get that?" said the clerk in a self-service grocery store as he stared at a package of shortening atop her basket. "We had shortening yesterday, but it was sold out in a few minutes."

"I know," said the shopper triumphantly, "I was here yesterday, too, but didn't have enough money, so I hid the shortening in the store until today!"

Doctor: Have you been leading a normal life?

Patient: Yes, Doctor.

Doctor: Then you'll have to give up women and whiskey for a few months.

Diplomacy—The art of cutting another guy's throat without using a knife.

The reason why my gal reminds me of a switchboard is because when she walks all her lines are busy.

A newlywed filling out his income tax return listed a deduction for his wife. In the section marked "Exemption claimed for children" he penciled the notation, "Watch this space!"

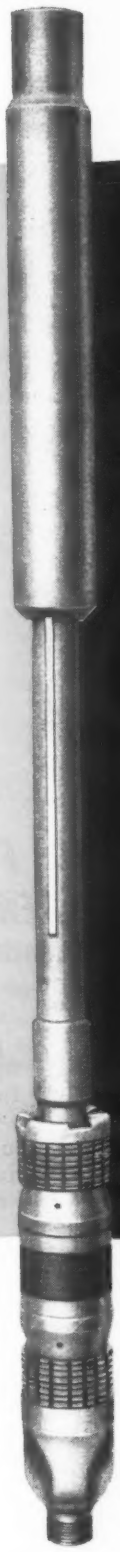
A very much married man we know says: "Before I married, I had six theories about bringing up children; now I have six children and no theories."

And now, Magnesium!

Baker Magnesium-Alloy Cement Retainers are now available to meet all the demands for this successful product. Similar in design to the cast-iron type, they are far easier to drill up. The only large parts not made of magnesium are the nitricastiron slips, which are readily broken up.

Baker Magnesium Cement Retainers (Product No. 5-400) are easily drilled up by using 2-inch tubing, and are readily drillable with cable tools. They are ideal for use as temporary bridge plugs, but the cast iron type should be employed for permanent bridge plugs where well fluids might affect the magnesium over an extended period of time.

If you are not now using Baker Cement Retainers for one or more of the applications listed at right, contact your nearest Baker representative or office for details of their successful use in your territory.



Modern operators find Baker Cement Retainers completely successful for:

Re-Cementing • Squeeze Jobs

Cementing Behind Sections of Pipe

Testing Upper Cased Formations

Reducing Gas/Oil Ratios

Cementing Bad Pipe

Plugging Off Bottom Fluids

Cementing Off to Perforate for Production

Cementing Two Strings Together

Cementing Low Pressure Zones and Other Similar Operations

Right, Baker Junk Basket, Product No. 428.

THE BAKER JUNK BASKET is recommended for the removal of cuttings when drilling up any "drillable" materials such as magnesium alloys, bronze, etc. It is run just above the bit, and operates on the principle that by reducing the velocity of the circulation fluid (in which these cuttings are carried) as it enters the larger annular area around the drill collar, the cuttings are dropped out of the fluid and trapped in the Junk Basket.

BAKER OIL TOOLS

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Having trouble preventing connection leaks?

You need RECTORSEAL, the chemically compounded sealant, developed especially for oil industry thread and gasket connections. It is composed of 15 synthetic, organic chemicals to withstand high pressures and temperatures; to provide high lubricating value for spinning up pipe; to be impervious to petroleum fractions; to maintain a plastic elasticity that will not "freeze" the connection.

Ask your supply store for RECTORSEAL No. 1. Use it on all connections for positive leak prevention.

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RECTORSEAL
THE POSITIVE LEAK PREVENTER

Fluor to exhibit

The Fluor Corporation, Ltd., of Los Angeles, engineers, designers and manufacturers of equipment for the oil and gas industries, will have a unique exhibit at the coming National Exposition of Power and Mechanical Engineering, to be held in New York City, December 2-7, 1946.

The exhibit will be a working model of the Fluor pulsation dampener, a device that changes pulsative flow into a smooth, steady stream. Pulsative flow, set up in air, gas, and vapor lines wherever reciprocating-type compressors are the source of power, has long been a problem for pipe line operators and compressor station engineers to mull over. The Fluor pulsation dampener, installed on either suction or discharge side of compressors, or both, by converting pulsative flow into a steady stream greatly reduces pipe line vibration and helps correct some of the other ramifications, such as horsepower losses, inaccurate orifice meter readings, and vibration due to air surge on engine intakes.

Fluor's working model consists of a small electric-driven compressor with pulsation dampeners installed on both the suction and discharge sides. A lever on either side enables the spectators to route the flow through the pulsation dampener or to bypass it. When the dampener is in operation, a pressure gage remains motionless, but when the dampener is bypassed, the gage vibrates considerably. A pressure-recording chart is also hooked up to graphically depict the difference between pulsative and steady flow.

"Pat" Robinson promoted

Security Engineering Company, Inc., announces the promotion of L. G. "Pat" Robinson from California sales manager to assistant sales manager. Both by number of years experience and acquaintance with different oil territories, the assistant sales manager is well qualified for his new position. Beginning with the company early in Security's history, "Pat" Robinson has been stationed in Illinois, Canada, The Mid-Continent, Gulf Coast, and California.

L. G. "Pat" Robinson

"Oilwell" appointments

Personnel appointments in the sales department of Oil Well Supply Company, general headquarters of which are in Dallas, Texas, have been announced by this U. S. Steel Corporation subsidiary.

Named assistant general managers of sales were F. D. Smith and M. F. Hazel.

Named sales department managers were V. J. Waters, drilling equipment; J. S. Fuller, production equipment; C. A. Bell, used equipment, and M. D. Routzon, merchandise claims.

Each of the six officials named have been in "Oilwell's" general offices and will continue to make their headquarters in Dallas.

DRAFTSMEN

DESIGNERS AND CHECKERS
with experience on
Structural Steel and Concrete
Process Piping
Pressure Vessels

The Boston office of E. B. Badger and Sons Co., internationally famous chemical engineering organization, offers qualified men well-paying positions. This is a fine opportunity for men who would enjoy working in congenial surroundings and with pleasant cooperative associates. A personal interview can be arranged in your city. This is not a temporary position. Write, giving full details of background and experience, salary wanted, etc., to

Mr. William M. Rose, Personnel Director
E. B. Badger and Sons Co.
75 Pitts Street, Boston, Mass.

WANTED FOR FOREIGN SERVICE

REFINERY SUPERINTENDENT

We want a man of wide experience in topping, cracking, treating and all other phases of modern oil refinery operations, enabling him to take full charge of a large, complete refinery. Technical ability required and with it, exceptional initiative, executive ability and resourcefulness.

CHIEF ENGINEER

Must have wide and varied experience which qualifies him to take full charge of construction maintenance and process engineering of a large, complete oil refinery. Exceptional initiative, executive ability and resourcefulness required.

MARINE TERMINAL MANAGER

Thoroughly experienced in all phases of marine movements of petroleum products and the design, construction, operation and maintenance of a marine terminal.

Address Box 51
c/o THE PETROLEUM ENGINEER
P. O. Box 1589 Dallas, Texas

HELP WANTED—Measurement and Gas Metering Engineer. Graduate Engineer under 35 with experience to supervise and direct measurement and testing in connection with production and distribution of natural gas in Montana and the Dakotas. Address Box 53, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

HELP WANTED—Corrosion and Cathodic Protection Engineer. Graduate Engineer under 35 with some experience to supervise, direct and coordinate work of this character in connection with transmission of natural gas in Montana and the Dakotas. Address Box 52, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

Sales engineering positions—men 32 years or younger wanted to train for sales work. Some knowledge of oil production and college engineering training required. Please give brief details of qualifications. Address Box 55, c/o *The Petroleum Engineer*, P. O. Box 1589, Dallas, Texas.

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Precisionbilt, like a balance scale, J&L Permaset Pre-formed Wire Rope is designed for balance and built for quality by men of experience and skill.

J&L Precisionbilt Permaset Pre-formed Wire Rope is made of J&L Controlled Quality steel—it has the strength and stamina for the toughest jobs.

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JONES & LAUGHLIN STEEL CORPORATION

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J&L *Precisionbilt* PERMASET PRE-FORMED WIRE ROPE

In new quarters

James A. Lewis, president, Core Laboratories, Inc., has announced that removal of the research laboratory and general office facilities and personnel has been completed at the organization's new location on Fort Worth Avenue, Dallas, Texas. Also, the North Texas division of Core Laboratories, Inc., and the reservoir fluid analysis laboratory, both formerly located with the general offices in the Highland Park Shopping Village have been established at 6923 Snider Plaza. The general offices in Dallas are under the supervision of Lewis; W. H. Davison, assistant to the president; J. H. Campbell, vice president, and J. R. Phillips, Jr., assistant secretary and treasurer.

Lewis states that, in order to meet an increasing demand from the petroleum industry for petroleum reservoir engineering data and its application to practical usage in controlled reservoir performance, it has become necessary to broaden Core Lab's scope of operations throughout the United States and foreign fields. Most recent inquiries among the latter have been personal visits from representatives of Saudi Arabia and the French government.

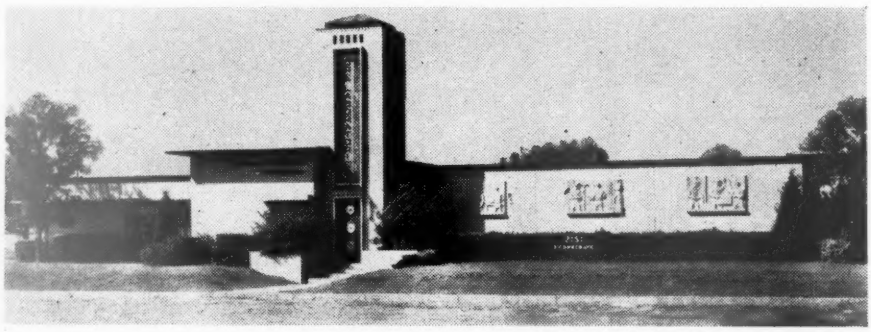
Core Lab's 26 portable and permanent laboratories operate from base points at Dallas, Houston, Corpus Christi, Texas; Shreveport, Louisiana; Evansville, Indiana; Bakersfield, California, and Rangely, Colorado. Sub-base points are Midland and Tyler, Texas; Independence, Kansas; Natchez, Mississippi; Lafayette, Louisiana, and Oklahoma City, Oklahoma. Engineers and laboratory technicians maintaining these locations include 38 veterans, 14 of whom were employed prior to their entry into various branches of the armed forces.

J. A. Lewis

J. H. Campbell

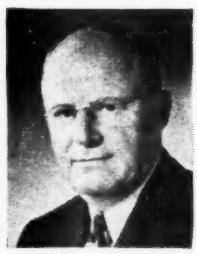
W. H. Davison

J. R. Phillips, Jr.



Heads Link-Belt

George P. Torrence, executive vice president of Link-Belt Company since July 1, 1946, became president of the company, effective November 1, succeeding William C. Carter.



George P. Torrence

Torrence, a graduate of Purdue University in mechanical engineering, class of 1908, in addition to his experience with Link-Belt Company, was general manager of Rayon Machinery Corporation, a subsidiary of Industrial Rayon Corporation, from 1936 to 1944; and president of Cleveland Pneumatic Tool Company from 1944 to 1946.

His experience with Link-Belt Company dates back to 1911, when he entered the company's employ in Indianapolis as draftsman, after having spent a year in Arkansas with the Ayer and Lord Tie Company as assistant oiler in the power plant, and two years as shop apprentice in the Pittsburgh shops of Westinghouse Air Brake Company.

In his 25 years with Link-Belt, Torrence served in various capacities beginning as draftsman. He was manager of the Indianapolis operations from 1926 to 1932 and president from 1932 to 1936.

Carter, who has been president since December, 1942, has retired from this position in accordance with the company's retirement plan. He continues as a director of the company and as chairman of the executive committee of the board. The other members of the committee are Howard Coonley and Russell Livermore.

These two Model VE-4 20 hp., 4-cylinder Wisconsin Air-Cooled Power units provide steady-going, all-weather dependability, driving rotary Lub-Oil pumps for a major oil company near Odessa, Texas.

No matter what type of equipment or power application the job calls for, Wisconsin Air-Cooled Engines deliver heavy-duty serviceability, easy starting in any weather, and complete freedom from cooling chores and troubles. Supplied in 4-cycle single cylinder models, from 2 to 9 hp., and V-type 4-cylinder models from 9 to 30 hp.

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Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

Statement of Ownership, Management, etc., of THE PETROLEUM ENGINEER
September 24, 1946

(This statement is published in compliance with the Act of August 24, 1912.)

Published at Dallas, Texas, monthly August through June, semi-monthly in July.

Publisher: The Petroleum Engineer Publishing Co., Dallas, Texas.

Editor: K. C. Sclater, Dallas, Texas.

Managing Editor: F. H. Love, Dallas, Texas.

Business Manager: W. T. Bryan.

Stockholders holding 1 per cent or more of total amount of stock: A partnership composed of W. T. Bryan, T. J. Crowley, W. L. Love and K. C. Sclater, all of Dallas, Texas, doing business under the name of The Petroleum Engineer Publishing Company.

Known bondholders, mortgagees and other security holders holding 1 per cent or more of the total amount of bonds, mortgages or other securities: None.

W. T. Bryan, Partner.

Sworn to and subscribed before me this 24th day of September, 1946.

Lillian H. Johnston, Notary Public.
(My commission expires June, 1947.)

P.E.S.A. secretary

H. R. Safford, Jr., Houston, Texas, has been appointed executive secretary of the Petroleum Equipment Suppliers Association, it was announced by Hugh H. Glen, president of the association.

H. R. Safford, Jr.

Safford, a Houstonian since 1924, is a former vice president of the Ritchie-Safford, Inc., advertising agency, and has been active in public relations activities as well as civic committee work in Houston. He has just returned from approximately four years' service with the Ordnance Department of the United States Army, during which time he was trained in and served as a Counter Intelligence Officer.

The new executive secretary was selected by a committee composed of directors of the association. The members of this committee were: Hugh H. Glen, president, Emsco Derrick and Equipment Company, Los Angeles, California; Ardon B. Judd, vice president and general manager, Republic Supply Company, Houston, Texas; W. M. Bovaird, president, The Bovaird Supply Company, Tulsa, Oklahoma; Ralph Neuhaus, vice president and general manager, Hughes Tool Company, Houston, Texas, and Guy A. Tompson, president, Bethlehem Supply Company, Tulsa, Oklahoma.

McCool promoted

M. G. McCool has been appointed vice president in charge of sales and manufacturing and a member of the board of directors of the American Iron and Machine Works Company, it has been announced by J. A. Gray, president. McCool joined the firm in 1935 and functioned as district manager in West Texas until 1940 when he became secretary and general sales manager at Oklahoma City.

M. G. McCool

Joins Elliott Company

Norman W. Stirling has joined the New York office organization of Elliott Company. Educated at Buchtel College, Annapolis, and the Naval School at Stevens Institute of Technology, Stirling was a lieutenant in the U. S. Navy during World War I at the conclusion of which he and two brothers established their own business as marine maintenance and general contractors specializing on marine engine condensers. In 1927 he joined the M. W. Kellogg Company in charge of sales of heat transfer and petroleum equipment. In 1944 he became manager of sales for the Whitlock Manufacturing Company.

As president of the Heat Exchange Institute for a one-year term and as president for three years of the Tubular Exchanger Manufacturers Association, of which he was also one of the organizers, Stirling has been exceptionally active in promoting the mechanical and thermal standardization of tubular heat exchangers for the petroleum industry.

IT'S THE FOOTAGE OF HOLE IN THE OIL SAND THAT COUNTS

NOW YOU CAN DRILL *WITHOUT* ROTATING THE PIPE

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Pacific petroleum division A.I.M.E. holds fall meeting

With W. W. Porter II, as chairman, the Pacific Petroleum Division of the AIME, held its Fall Meeting at the Ambassador Hotel, Los Angeles, October 24 and 25, and offered to its members a varied program of technical papers of unusually high merit. The morning session on the first day, under the chairmanship of W. S. Eggleston, Union Oil Company, with John DeHetre, Youngstown Sheet and Tube Company, as vice chairman, opened with a discussion on "Geological Interpretation of Radioactivity Well Logs," by J. E. Kilkenny, Chanslor, Canfield, Midway Oil Company, and concluded with N. A. D'Arcy's paper on "Hydraulic Couplings and Hydraulic Torque Converters as Applied to Drilling and Well Pulling Equipment."

The afternoon session was directed by Norris Johnston, General Petroleum Corporation, and co-chairman T. H. Acres, Richfield Oil Corporation. Papers for this period were: "Volumetric Behavior of Oil and Gas from Several San Joaquin Valley Fields," by B. H. Sage and R. H. Olds, California Institute of Technology; "Reservoir Mechanics of D-7 Zone, Ventura Field," by E. V. Watts, General Petroleum Corporation; "Recovery of Condensate from a Distillate Type Reservoir by Gas Cycling," by Marshall B. Standing, Standard of California.

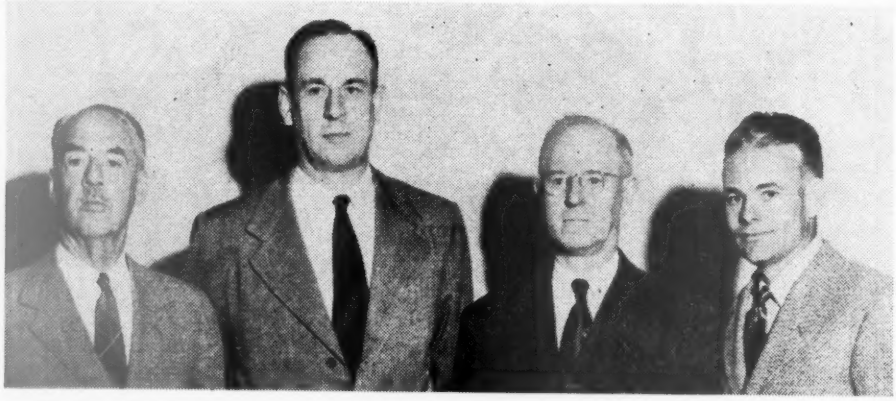
On Friday morning, Wilhelm Tempelaar-Lietz, Shell Oil Company, and N. Van Wingen, Richfield Oil Corporation, officiated as co-chairmen. John Gates of Shell Company presented a paper, entitled, "Laboratory Results Concerning Selection of Drilling Fluids for Use with Fine Mesh Liners;" Vaughn Moyer, Union Oil Company, discussed the "Decrease in Ultimate Recovery Due to Lowering of Productivity Indices;" and C. H. Dresbach, Western Gulf Oil Company, collaborated with Paul Weaver, Gulf Oil Corporation, on a "Review of Geophysical Prospecting Devices, Methods and Procedures."

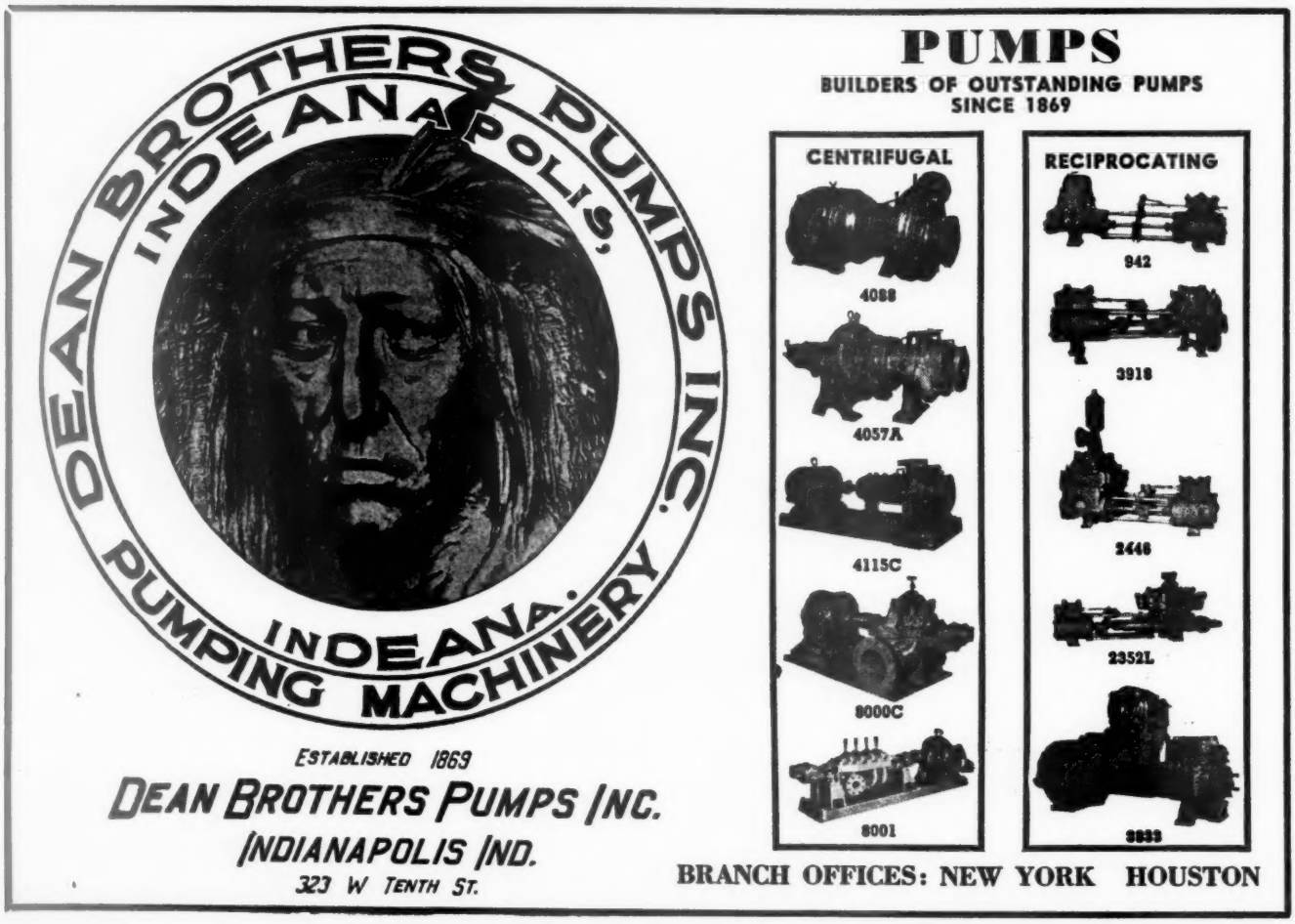
The final session, with A. W. Gentry, Long Beach Oil Development Company, and John R. McMillan, Fullerton Oil Company, as co-chairmen, produced some real excitement. First speaker was A. C. Rubel, vice president of Union Oil Company, comments on whose address will be found elsewhere in this issue. Following the Rubel talk on "What Management Expects of Engineers," the reverse side of the picture—"What Engineers Expect of Management," was expounded by E. K. Parks, consulting petroleum engineer.

It was emphasized in the beginning that these two addresses did not by any means constitute a debate, and that while Rubel's paper represented his own opinions on the management-engineer relationship, the Parks presentation was a factual and statistical report of a survey, given just as it developed, without coloring of any sort. Both papers, however, promoted lots of discussion, and there is no question that this type of paper is a popular one with the Petroleum Division.

The Parks report brought out some rather startling information, particularly with regard to the stand of the questionees on unionization. An appreciable percentage of the engineers answering the questionnaire were of the opinion that unionization was desirable, the largest proportion of this particular group being in the longer service

Officers Southern California Section AIME. H. R. Van Wagenen, vice chairman for mining; H. J. Clark, secretary-treasurer; E. O. Slater, chairman, and T. A. Atkinson, vice chairman for petroleum.





ranges, that is, with more than 10 years' experience.

The Fall Meeting wound up in fine style with a banquet for the entire Southern California Section of AIME. It was held in the Embassy Room, and a record crowd assembled to hear a delectable address, "Recent Observations in Europe and Cypress," by past president, Harvey S. Mudd, and one on "Foreign Trade Relations," by President Cates. Cates announced during the evening that the Lucas Medal for 1946 had been awarded to Dr. Lacey, dean of the graduate school at California Institute of Technology, for his outstanding hydrocarbon researches. It was also revealed that John R. McMillan, Fullerton Oil Company, had been elected chairman of the Pacific Petroleum Division for 1947. At the same time, A. W. Gentry, Long Beach Oil Development Company; F. Parker, Signal Oil and Gas Company, and R. S. Parsons, Standard of California, were elected counsellors for the next term.

Joins Tagliabue

F. R. Marlier, president, Portable Products Corporation, Pittsburgh, has announced the appointment of Henri M. Marc as assistant general manager of the corporation's C. J. Tagliabue Division, Brooklyn. Born in France, Marc served in the U. S. Army during World War I, and graduated from Carnegie Institute of Technology in chemical engineering in 1922. Thereafter he was associated for a number of years with the Mellon Institute of Industrial Research, Pittsburgh, conducting research on asphalt, asbestos, and organic felts. He joins Tagliabue from the Philip Carey Manufacturing Company, Cincinnati, with which he has been associated since 1932 as assistant director of research, developing asbestos, mineral wool, and other heat and sound insulating products.

Henri M. Marc

The C. J. Tagliabue Division manufactures a wide line of instruments for recording and controlling temperature and pressure. In addition to his managerial duties, Marc will act as technical advisor for all divisions of the corporation.

Manager sales

The appointment of Martin J. Rampp as manager, oil field sales, eastern division of International Derrick and Equipment Company has been announced by O. M. Havekotte, president. Rampp will maintain his headquarters at Marietta, Ohio, where he will continue to manage the Marietta plant in addition to his new duties. Rampp will supervise the direct sales of oil field and water well equipment as well as sales through dealer outlets in the eastern division.

Oronite sales manager

Appointment of H. E. Bramston-Cook as general manager of Oronite Chemical Company, Standard of California chemical subsidiary, has been announced.

Bramston-Cook, who served in the Navy as a line captain, is widely known in the oil industry for his activities in manufacturing, research, and sales.

A native of England, Bramston-Cook was brought by his family to Canada's Northwest Territory in 1903. He received his master's degree in chemical engineering from the University of British Columbia in 1924 and spent the next two years there as a graduate student and lecturer. Afterward he was in charge of a survey made into California's sources of sand for glass manufacture.

In 1927, Bramston-Cook went to work for Union Oil Company's research department. Subsequently he held important posts at the Oleum refinery, then in the technical products department, specializing in the development and distribution of high solvency naphthas.

Bramston-Cook was Union's manager of technical products sales when the Navy called him to active duty as a lieutenant commander in August, 1941.

General Petroleum builds

Construction of the first height-limit building to be erected in metropolitan Los Angeles for more than a decade will be undertaken in the near future by General Petroleum Corporation, western affiliate of the Socony-Vacuum Oil Company, it is announced by S. J. Dickey, president of the corporation.

The completely modern office building will be a half block deep and will front on the east side of Flower Street for an entire block, extending from Sixth Street to Wilshire Boulevard. Representing an overall investment to exceed $5,000,000, the building will consist of a street floor and 12 additional stories.

Start of construction is contemplated about July, 1947, Dickey said.

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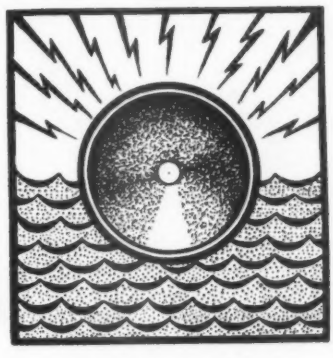

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C.N.G.A. meeting

One of the biggest and best in its history, was the popular verdict on the California Natural Gasoline Association Fall Meeting, held in the Ambassador Hotel, Los Angeles, October 11. After a stimulating all-day program of technical papers, the meeting wound up with a dinner at which were seated approximately 750 members and friends, and topped off the whole business with a Phil Mettling vaudeville show that had the big audience rolling in the aisles—at least, we hope that was what made them roll in the aisles. In any case it was a bang-up show that was chock full of typical old time variety stuff, and just the right measure of feminine charm. Charm—that is, son! It was a right enjoyable two hours of relaxation for the technical lads and they showed their appreciation in no uncertain manner.

Ed Ragatz, of Bechtel Brothers and McCone Company, was one of the busiest men in Los Angeles that day. He was chairman of the meeting, presided over the morning session, and presented a paper in the afternoon. Under his direction, the morning meeting featured two fine papers: "Economic Outlook for California LPG," by Clare Gard of Union Oil Company, and Hugh Colvin, consulting engineer; and "Fat Oil De-ethanization," by A. M. Whistler, C. F. Braun and Company. Both papers were well received, and were followed by lots of discussion, which is usually a pretty good measure of their interest and reception.

The afternoon session was under the chairmanship of Vice President Frank J. Colton and following his introductory remarks, was turned over to Jim Kibre for his presidential address. Jim, while expounding on the status of the organization, and the future of the natural gasoline industry, took occasion to pay special tribute to the national association—the NGAA, which was well represented at the meeting. Drs. B. H. Sage and W. N. Lacey of California Institute of Technology, in collaboration with Robert H. Olds, research fellow, then presented a paper entitled, "Tentative Partial Enthalpies of the Lighter Hydrocarbons." These authors are well and favorably known for the work they have already done in determining the values for enthalpies of single component light hydrocarbon systems. This latest contribution dealt with partial enthalpies of these hydrocarbons, when present in multicomponent systems.

The balance of the program consisted of a paper, "Conversion of Natural Gas to Liquid Fuels," by R. C. Alden, Phillips Petroleum Company, which treated of the conversion of residue dry gas into commercial motor fuel, and the technical and economic aspects of the process employed. This was followed by Ed Ragatz' presentation, "Evaluation of Absorber Operating Efficiency." The speaker offered a new approach to one of the natural gasoline engineer's most perplexing problems, and took occasion to question the infallibility of procedures now employed, under the specific conditions which prevailed in the long series of actual field tests reported. It was a typically provocative Ragatz offering, and a fitting climax to a highly successful meeting.

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Fluor promotes

W. Earl Dunn, vice-president of The Fluor Corporation, Ltd., who has been in charge of the Kansas City office since 1930, has been promoted to the position of general manager, effective October 1. Dunn will make his headquarters in the Los Angeles office.

James P. "Jim" Wiseman, former district engineer in Fluor's Houston office, has been upped to the post of general sales manager, effective October 1, and is now in the Los Angeles office.

W. Earl Dunn

J. P. Wiseman

Foreign representative

The Houston Oil Field Material Company, Inc., announces the appointment of D. U. Skinner as foreign representative, and transfer of his offices from Houston to Caracas, Venezuela, South America.

Skinner, formerly sales and public relations man for the manufacturing and cutting and fishing tool and directional drilling service departments of Homco, will make his headquarters in Caracas while serving the entire petroleum industry in Central and South America. He will aid in sales work and will be available as an experienced consultant for any cutting and fishing tool problems in that locale. Skinner left the United States from Miami on October 16 and arrived in Caracas the same date.

The Houston Oil Field Material Company's export representative is E. F. Gahan, 500 Fifth Avenue, New York 18, New York.

New well service

Brown Well Service of West Texas celebrated the opening of a large, modern shop at Odessa, Texas, late in October with a barbecue for several hundred operating men. The new shop is providing service throughout the entire Permian Basin region on the reconditioning of drill collars, subs, and Kelly joints.

H. C. Brown

H. C. Brown, vice president and manager of operations for Brown Well Service of West Texas, is one of the organizers of this modern service. He is an oldtimer in oil tool shop management, having begun as an apprentice with Union Tool Company at Taft, California. He joined Baash-Ross Tool Company in 1919 and served that company for 25 years, including the early days in Oklahoma City and the Baash-Ross Houston shop. He resigned January 1, 1946, to enter business for himself.

C. C. Brown, head of Brown Oil Tools, Inc., Houston, and Brown Well Service in the Gulf Coast, is president of Brown Well Service of West Texas.

To South America

John A. "Jack" Clemens, veteran Martin-Decker sales engineer who has been with the company for 18 years is on a six months' trip to South America for the purpose of assisting customers in the use of Martin-Decker products. Leaving New York late in November by air, Clemens' itinerary will include Trinidad, Colombia, Equador, Peru, Chile, Argentina, Brazil, and Mexico. On his return to this country, Clemens will again direct Martin-Decker operations in the Gulf Coast and Mid-Continent areas from his Houston headquarters, a position which he has held for the last nine years.

J. A. Clemens

Sales manager

L. J. Renner has been appointed Mid-Continent wire rope sales manager for the Wickwire Spencer Steel Division of The Colorado Fuel and Iron Corporation.

L. J. Renner

Renner will have his headquarters at 1502 Fort Worth National Bank Building, Fort Worth, Texas. His appointment will facilitate the service rendered to the many users of Wickwire Spencer Wire Rope throughout the Mid-Continent area. He previously handled the sale of wire rope in the Chicago district office.

Dr. Johnston retires

Dr. John Johnston has retired as director of the research laboratory of United States Steel Corporation of Delaware, it has been announced by Benjamin F. Fairless, president of the corporation. He will be succeeded by Dr. J. B. Austin, assistant director, who studied physical chemistry under Dr. Johnston at Yale University and has been associated with him at the laboratory since its inception. Dr. Johnston plans to live in Maine following his retirement.

The laboratory was established under Dr. Johnston's direction in Kearney, New York, late in 1928 with a small staff of metallurgists and physical chemists for the purpose of improving the quality of steel. Today the scientists who devote full time to the study of suiting various steels to their many tasks number 57 in the laboratory itself while several thousand others are engaged in research in the laboratories of U. S. Steel operating subsidiaries.

Employe bonuses

Standard Oil Company of New Jersey has announced a bonus of one week's pay for all employes up to the first supervisory level, not including clerks or pipeliners. In effect, the bonus will be paid to refining and marketing personnel.

Stanolind, effective October 1, raised hourly rated personnel by 4 cents per hr.; salaried personnel subject to the wage and hour law by $7.00 per month; other salaried personnel earning up to and including $400 per month, by $20 per month; and, effective November 1, salaried personnel earning from $401 to $600 per month by 9½ per cent.

Humble, beginning in October, is paying all employes a bonus of $25 per month for four months, making a total of $100.

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For oil, gas, gasoline pipe lines and water conduits.

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For use on tanks which are to serve underground or under water; also for waterproofing cement.

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For use on metal exposed to erosion and abrasion, and to the action of fresh or salt water.

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A protective coating, available in colors, for metal and concrete surfaces.

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Reilly Aluminum Coating is also recommended for use on other metal, wood, cement, brick and stone surfaces. One coat gives adequate protection. Available in 1 and 5 gal. cans and 55 gal. drums.

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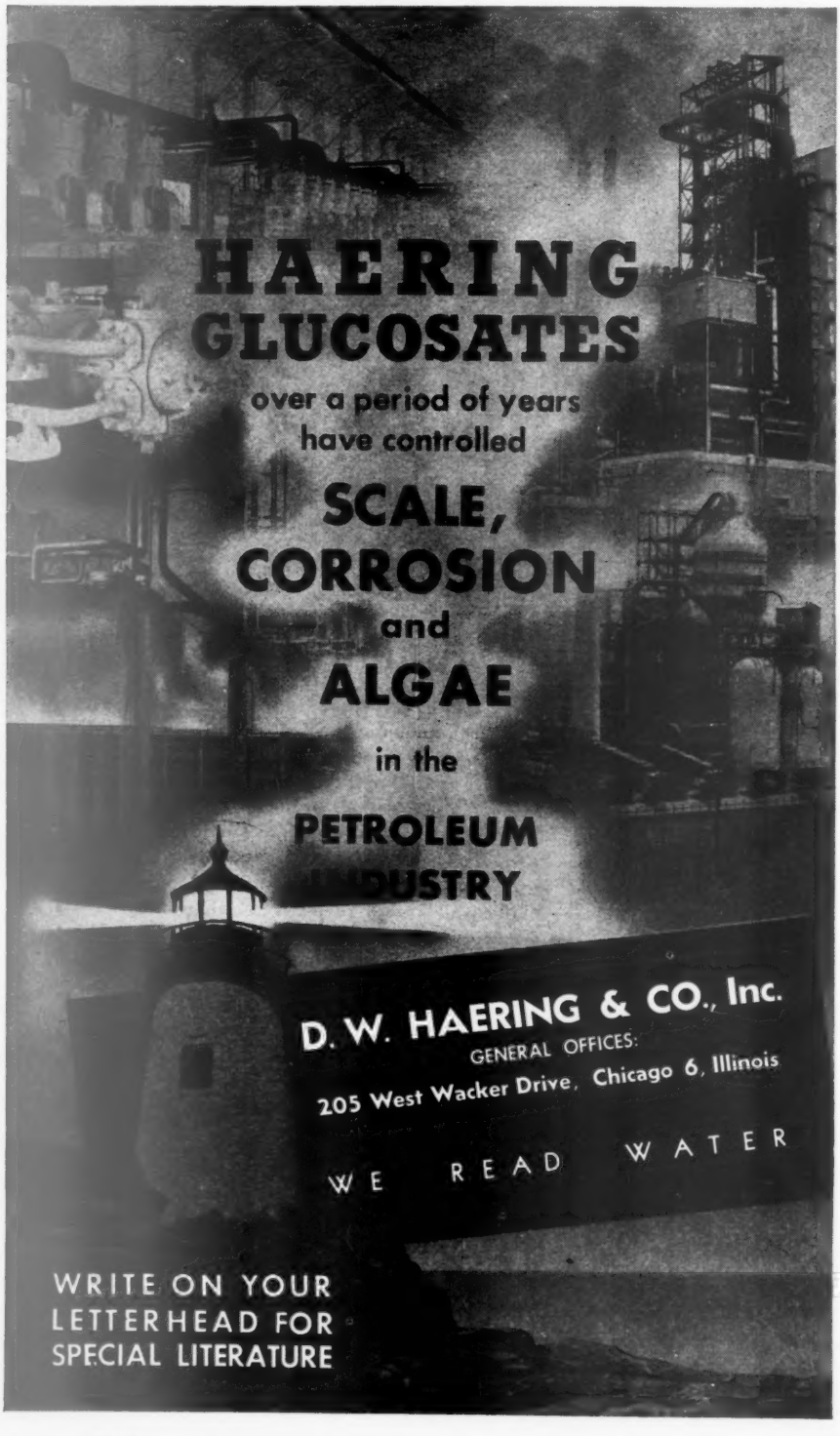
Reilly Protective Coatings

Officers East Texas Section A.I.M.E.

The officers of the East Texas Section of the AIME who attended the meeting at Kilgore, Texas, on October 21, 1946, are as follows: Left to right: D. W. Akins, Jr., Shreveport, director; Riley A. Aucoin, Tyler, chairman of the section; Tom C. Frick, Greggton, program chairman; Don M. Kerr, Kilgore, secretary-treasurer; Albert S. Trube, Kilgore, membership chairman; John Moore, Kilgore, director, and Paul Moir, Kilgore, publicity chairman. Not shown in the picture are the guest speaker of the evening, John Bell, Tyler, who presented a paper on "Geology and Development of the Hawkins Field," and Charles B. Carpenter, Dallas, regional vice chairman of the Petroleum Division of the AIME.



In charge operations

C. R. Dobson

H. K. Porter Company, Inc., has announced the election of C. R. Dobson as vice president in charge of operations.

Dobson, formerly chief industrial engineer of the Jones and Laughlin Steel Corporation, will supervise operations of the seven Porter manufacturing plants.

Torrington appointments

The Torrington Company, Torrington, Connecticut, and South Bend, Indiana, announces recent district engineer appointments in connection with the company's anti-friction bearing activities, as follows: Chicago, Illinois, Frank H. Marchand, district manager and Ray G. O'Connell and C. R. Recor, district engineers. At Torrington, Connecticut, Cincinnati, Ohio, and Los Angeles, California, new district engineers are, respectively, Buell D. Dean, Fred J. Norman, and Frank B. Tipton.

A.P.I. division meeting

E. V. Watts, General Petroleum Corporation, has been appointed general chairman for the 1947 Spring Meeting of the Pacific Coast District Division of Production, American Petroleum Institute. The appointment was announced by M. W. Morris, Standard of California, chairman of the Pacific Coast District.

The meeting will take place May 15 and 16 at the Biltmore Hotel, Los Angeles.

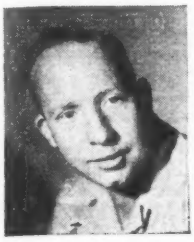
Watts is organizing committees to take care of the various activities of the meeting, which has grown to outstanding proportions in recent years, and will announce the personnel later.

Field changes

A. L. Gooden

A. L. "Preach" Gooden, formerly of Alice, Texas, has been transferred to Rangely, Colorado, by Patterson-Ballagh Corporation, where he will handle sales and service of oil field rubber specialties. He will not cover the Casper area, for J. B. Buchanan, who also works for Byron Jackson Company, will handle the Patterson-Ballagh line in that territory.

J. M. "Jimmie" Patterson-Ballagh Newton, who joined in July, 1944, has recently returned from a trip to the California plant to familiarize himself with the new equipment and methods being used in the manufacture of Patterson-Ballagh products. Newton is now stationed at Baton Rouge, Louisiana, and covers the fields in Mississippi and the Harvey, Louisiana, district. He was formerly employed by the Hunt Tool Company, Jennings, Louisiana.



J. M. Newton

Wiley B. Gardner, well known in the fields of Louisiana, Arkansas, Mississippi, East Texas, and Oklahoma, is now living in Mooringsport, Louisiana. He has represented Patterson - Ballagh since 1937 in all these fields and has just completed a trip to the factory in Los Angeles, where he studied the new plant, methods and equipment being developed by the company. From Mooringsport he covers sales and service in the northern Louisiana, Arkansas, and East Texas fields.

W. B. Gardner

C. J. "Chili" McKernan, who entered the employ of Patterson-Ballagh July 1, 1946, is now stationed at Odessa, Texas. Previously, McKernan worked for the Wilson Supply Company in southern Louisiana. During the war, he was a captain in the Air Corps. After being discharged last December, he reentered the employ of Wilson Supply Company Company and was stationed at Natchez, Mississippi. McKernan will be patterson-Ballagh's factory representative in West Texas, Panhandle, and New Mexico area.

C. J. McKernan

H. H. "Bud" Collins is now sales and service representative for Patterson-Ballagh in southwest Texas, where he has taken over the territory formerly served by A. L. "Preach" Gooden. "Bud" is well known throughout the Houston Gulf Coast area, where he formerly worked for the Wilson Supply Company prior to joining Patterson-Ballagh in early months of 1944. In May of that year he joined Uncle Sam and went to Japan, where he remained until just before his discharge in June, 1946. He is working out of Alice, Texas, where Patterson-Ballagh headquarters for the southwest Texas area is situated.

H. H. Collins

Pioneers' party

Lou Bronzan, Baash-Ross exec, and program chairman of the Petroleum Production Pioneers, announces that plans have been completed for the staging of a Year-End Party, on Friday, December 13, at the Roger Young Auditorium, 1936 West Washington Boulevard, Los Angeles. The petrolic oldtimers and their guests will assemble at 5:00 p. m., and will entertain themselves and be entertained, until the dinner hour at 8:00, when—with the lid off meat—they will be given an opportunity to make up for any scarcity of red corpuscles occasioned by the late, lamented meat famine.

This promises to be one of the greatest gatherings of oil pioneers in the history of the California petroleum industry, and it is purposely being held in advance of the Wildcat and other Christmas parties, so that there will be nothing to interfere with a full attendance. The executive board, headed by Jim Gosline, Standard of California, has established a major project for the coming year, a roundup and enlistment of all production pioneers in the state. The organization is still growing by leaps and bounds, and already numbers among its members many men who were responsible for, or involved in, significant developments in the pioneer days of the California oil industry.

The Year-End Party will, as usual, offer the members and their friends ample time and opportunity to mix around, and indulge in the reminiscence exchanges that are a most popular feature of the meetings. There will be some entertainment of a professional nature, of course, but the real entertainment is likely to come from the chance meetings of old friends who haven't seen each other for years.

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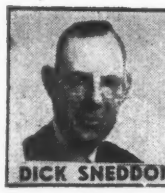

Pacific Personalities

DICK SNEDDON

It's a long time since this thing happened, how long we don't know, but it still makes an interesting story, and it still gives an intimate glimpse of life as it was lived in the petrolic wilds about three decades ago. The scene was McKittrick, where for some time in a certain field warehouse there had been lying an accumulation of dry cells—some old, some new. Nobody appeared to be paying much attention to them, except the district gauger, and why he should be interested would be difficult for anyone unfamiliar with local conditions and relations to guess, because dry cells don't usually play much part in the gauger's routine. In these days, however, nearly all pipeliners were gamblers, and as a matter of fact we know one or two today who think the greatest diamond ever discovered was the ace. Anyway, 30 years ago, they used to sit up nights evolving ways to reduce the Dun and Bradstreet ratings of their associates. Thus it was that continued concentration on the aforementioned dry cells finally suggested to the district gauger a deep and dark scheme.

Borrowing a galvanometer, he carefully tested every dry battery in the heap, and put an identification mark on all the good ones, being sure, of course, to leave them all in a profound state of disarrangement. Then like the spider of story and song, he sat quietly waiting for the fly to walk into the trap. It didn't take long. Presently, in came a large, luscious fly, in the person of the district foreman. Having cast a scrutinizing eye around he finally noticed the bait. "Are these dry cells any good?" he asked. "I guess so—some of them," innocently replied the gauger. "Well, you'd better pick out the good ones and throw the rest away," suggested the boss. "OK," said the gauger, and without further parley, he chose one from the bunch, smelled it, and threw it roughly over in the corner.

"Hey! Whatcha doin'?" the foreman demanded with some heat. "Pickin' out the good ones," says the gauger, undisturbed. "You can't do it that way, you crazy," the boss came back, and the gauger challenged. "Oh, no? Do you want to bet?" Witnesses were brought in, the bets were turned over to the official stakeholder, and the gauger smelled each battery in turn, laying the good ones on the right, and the bad ones on the left. An ammeter was then brought in, and it checked the smelling system 100 per cent, whereupon the district foreman paid off, but it was obvious that he smelled something, too—a rat, and by a peculiar coincidence it's name was the same as that of the gauger.

▪

And now that we have disposed of another significant chapter in the petroleum history of California, let's see what goes on at the moment: Had a talk with Ned Babson a short time ago, just after he had made a mighty fine speech to the AIME boys (Petroleum Section) at the GP auditorium, and learned much to our surprise that he is getting out of the oil business and is going up to Oregon to help his folks handle a wholesale plumbing business. The surprise is especially acute since Ned was rapidly becoming regarded as one of the up and coming engineers. Somehow, we kinda think he'll be back one of these days—trying to develop a formula for predicting reservoir behavior. Incidentally, we might mention that Jan Law did a mighty nice job of presiding at this AIME meeting—he has a nice platform manner, lots of vocabulary, and uses it only when he has something interesting to say. Reminds us of the speech expert who said the best oration was one that had a very short introduction, an equally short conclusion, and practically nothing in between.

▪

While we are passing out bouquets, Martin Van Couvering is certainly to be congratulated on the way he has developed that AAPG study group. Martin also does a neat job of MCing and in addition has continuously arranged worthwhile programs over the past two years, so that the Pacific Coast members just hate to miss his sessions. We attended one recently at Cal Tech—and heard Read Winterburn demonstrate why he is now regarded as *the* expert on Wilmington. This was a strictly extemporaneous chat but there wasn't much left out. We used to live in Wilmington, and always remember that there was a resolution in the session records of the Calvary Presbyterian Church down there, as follows: Resolved, To send a missionary to the struggling little town of Los Angeles that is rapidly growing to the north. Getting back on the beam, however, Read not only delivered a pretty complete dissertation but answered questions that would certainly have stumped Dr. I. Q.

On the same program was Hugh McClelland of Continental expounding a species of mathematics that was so far above our head we finally became hopelessly lost in a forest of sines, cosines, and tangents. All this was in explanation of his mathematical approach to the determination of true strikes and dips in deflected holes. Although

slightly beyond our feeble intellect, the subject seemed to be of interest to the assembly and there was much wrinkling of brows and questioning of method, which appeared to be pertinent but of course we couldn't be sure. Through it all, Martin Van Couvering handled himself with a general competence and aplomb that somewhat explained the growing popularity of these meetings.

The last speaker of the evening was Peter Gardett of General Petroleum, and in Peter we really found a congenial soul—one we could understand from beginning to end. Here is a geologist with a keen sense of humor! Discussing a system of filing geological maps of diverse sizes; well logs that are long and narrow, or short and wide, depending on the temperament of the operator; reports that are letter size and legal size, thick or thin, he slowly and carefully delineated a procedure from the complexity of which he emerged with the profound conclusion that the answer to the whole problem was to hire a smart secretary and quit worrying.

After the meeting was over, the group, at the invitation of Dr. Chester Stock, lingered in the paleontology museum and consorted with a brontosaurus or something of the sort. Whatever it was, it was well ventilated! Among the spectators we noted Owen Haynes and Herschel Driver of the S. O. Company; Harvey Lee, the well known scout from Union Oil Company; Frank Parker, Signal Oil and Gas; Roy Barnes of Continental; Bob Atwill of Union, president of the Pacific Section of AAPG, and a host of other interesting and interested people. All of which goes to show as we originally intimated that Martin Van Couvering is doing very well with his study forum.

•

Most oilmen in California have at some time or other met Carl Abell, long time member of SAE, and field engineer for the Ethyl Corporation. Well, Carl is following in the footsteps of Ned Babson, and is going out of the industry to turn his hobby into a business. For lo these many years he has been playing around with fly fishing equipment of all sorts, and can make a Royal Coachman that only needs a Royal Coach to make it look absolutely human. Anyway, over in Burbank, where the Abell residence is situated there is rapidly shaping up a factory that will devote itself to trout lures and wiles, and all the other conveniences and contraptions that make fishing so fascinating for such a healthy proportion of the American populace. We have it on good authority that some of Carl's flies are so natural the fisherman has to turn his back on the stream while attaching the snell to the leader.

•

Ken Evans, the well known ping pong expert, and former president of the San Joaquin Valley Oil and Gas Association, has relinquished that post and has turned it over to Don McFadden, another Union Oiler. The ping pong reference may be a little bit obscure, but some ten years ago, a little group of production men used to while away the few minutes that remained after lunch in Union's head office playing this rugged game. Ken was one of the champs, and rumor has it that he did quite well in a financial way, much to the disgust of some of the more spectacular performers.

•

Lee Priest, operator at Shell's refinery at Coalinga, where he has been stationed for the last 18 years, and has made a host of friends, is retiring to his recently purchased home in Ventura where he will henceforth devote himself more fully to his two favorite pursuits—gardening and photography. When one of these general information experts once announced in Lee's hearing that there were 10,000 Poles in New York, he exclaimed, "My gosh, what a place to raise dahlias!"

•

While we are speaking of Shell company people, another man who is decidedly in the news at the moment is Bill Feistner, division foreman of construction and maintenance in the Los Angeles Basin. Bill has just completed 30 years with the company, and has had a mighty interesting career in the California oil fields. He wore the west's first asbestos suit, when he helped to subdue a bad fire in Nesa No. 1 on Signal Hill in 1921. He is a baseball fan of the first magnitude, has managed Shell teams for years, and if you don't think that is something, remember this—37 professional baseball players have come out of his teams. Incidentally, one of the best baseball stories we know developed during the recent World Series, and accidentally, too, when one of our local newspapers reported, regarding one of the players, "On a short bunt, he wet all the way to first base." Must have been an exciting game!

Gardner-Denver general sales manager

G. V. Leece, vice president of Gardner-Denver Company, has been appointed general sales manager for the Gardner-Denver Company, effective immediately. Leece joined the Gardner-Denver Company in 1922 and is now rounding out approximately 24 years of service. For the last two years his position has been that of vice president in charge of the export division with offices in New York City. For five years previous to this appointment, he was district manager of the New York branch office and for seven years prior to this period he had been Pacific Coast manager.

Leece, who is also a director of Gardner-Denver Company, will now be at the company's plant at Quincy, Illinois.

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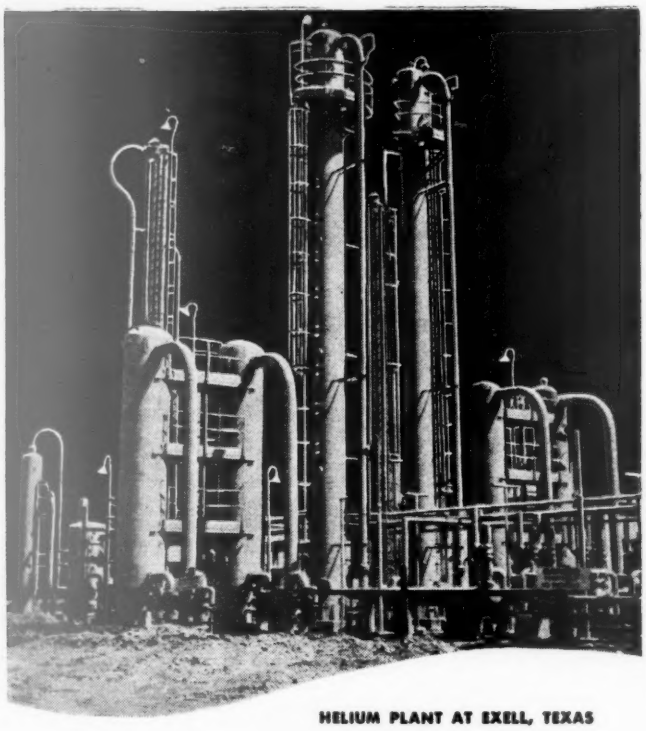

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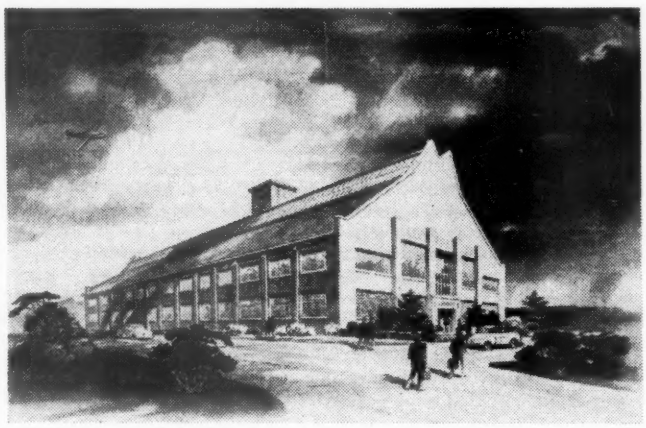
New Kellogg laboratory

A complete new group of pilot plants now building for extensive industrial research to prove the feasibility of a wide range of new processes and their application to many basic industries, has been announced by L. H. Harvison, executive vice president of The M. W. Kellogg Company, chemical engineers of Jersey City, New Jersey, and New York, New York. Harvison stated that the Kellogg company, whose Jersey City laboratory operations in the petroleum refining and related fields have for years represented an annual investment running into seven figures, now is embarking on a comprehensive program of expanding these facilities.

One of the major units of the new laboratory is the pilot plant for a special solvent process for refining of edible oils, vitamins, fatty acids, tallow, and other glyceride products. Towering high in the air, this pilot plant has already been completed and is now in operation.

Following the successful tests of the process over several years, engineering of installations is proceeding with both domestic and foreign companies, processing a variety of glyceride products.



Artist's concept of the new Jersey City laboratory now building by The M. W. Kellogg Company, chemical engineers of Jersey City, New Jersey, and New York, New York. This latest addition to the company's extensive laboratory facilities will house complete new group of pilot plants covering a wide range of new processes and their application to many basic industries. Pilot plant for special solvent process of refining edible oils, vitamins, fatty acids, tallow and other glyceride products is already completed and in operation.

Homco personnel changes

The Houston Oil Field Material Company, Inc., announces the following personnel changes:

R. M. Freeman has been appointed assistant district manager of the West Texas district. He was formerly store manager at Eunice, New Mexico.

Harry J. Bish has returned to Homco and will work as cutting and fishing tool operator in the Houston district. He was formerly employed by this company before entering the armed forces. Eugene E. Campbell has been employed as warehouseman at the Harvey, Louisiana, store. Temple O. Davidson recently joined Homco and will work as maintenance man in the cutting and fishing tool department at Corpus Christi.

P. M. Neal has returned after an absence of approximately two years and will be salesman in the Houston district. H. O. Price and Elbert L. Burns, Jr., former employes before entering the service, have returned and are warehousemen in the Houston store. W. M. Skinner has been employed as warehouseman at Raymondville, Texas. Patrick J. Dougherty has been promoted from warehouseman to field salesman at Natchez, Mississippi.

Mid-Continent sales manager

O. M. Havekotte, president of International Derrick and Equipment Company, has announced the appointment of C. A. McClelland as manager, Mid-Continent direct sales. McClelland will maintain headquarters at the central sales office in Dallas, Texas.

McClelland has spent many years in the oil fields and has engaged in drilling and production in addition to the marketing of supplies and equipment. He has been associated with Ideco for more than ten years. He is a member of the Dallas Petroleum Club and a charter member of the Dallas Chapter of Nomads.

Expands staff

A group of 45 new sales and service engineers have been added to the expanded field staff of the Brown Instrument Company, Philadelphia.

The group of 45 sales engineers and service men will be assigned, about the first of the year, to various regional offices and branches throughout the country, Steinkamp said. All are now attending the Brown company school of instrumentation at Philadelphia.

Book Reviews

• **The Life of a Chemist,** *by Dr. Vladimir N. Ipatieff. Published by Stanford University Press. Price, $6.00.*

Seventy-nine-year-old Dr. Ipatieff, Russian-born scientist who is professor emeritus of chemistry at Northwestern University, has just published his autobiography.

The recipient of many foreign and American scientific awards, and holder of more than 150 United States patents for chemical processes, Dr. Ipatieff was honored in 1943 as co-inventor with Dr. Vladimir Haensel of triptane. They developed a system of making triptane that brought the cost down from $3,000 per gallon to less than $1 a gallon and saved millions of barrels of crude oil a year during the war.

A chemist for 54 years, he won the Willard Gibbs medal in chemistry in 1940. In the same year, he was given the "Modern Pioneers" award of the National Association of Manufacturers. Other awards include the "Palmes Academiques" and the Lavoisier medal of the French Chemical Society, both in 1939; and the Fawcett Publication, Inc., award in 1944. The original manuscript of "The Life of a Chemist" was written in Russian, and was translated by his colleague, Dr. Haensel, and Mrs. R. H. Lusher.

• **Petroleum Production Engineering,** *by Lester Charles Uren. Published by McGraw-Hill Book Company, 330 West 42nd Street, New York 18, New York. Price, $7.00. Pages, 764.*

In this third edition of "Oil Field Exploitation," Lester Uren, Professor of Petroleum Engineering, University of California, deals with the principles of drainage, with production practices and equipment and with closely related subjects of handling and treating crude oil on the producer's property, and with storage and transportation of crude petroleum.

In this volume, the needs of the petroleum-engineering student have been ever uppermost in the mind of the author; yet it is hoped that the material may be found helpful as a reference manual by the oil company executive and the engineer of less specialized training.

Some of the material in this volume was originally published in *The Petroleum Engineer.*

• **When the Oil Wells Run Dry,** *by Walter M. Fuchs. Published by Industrial Research Service, Dover, New Hampshire. Price, $3.75. Pages, 447.*

What is oil and how was it formed? Where and how is it found? How is it refined? And how will we run our automobiles, our airplanes, and our tractors when the oil wells run dry? These and many other vital questions are answered in this book, in words that everyone can understand, by a man who not only knows the oil problems of America but was closely connected with the synthetic oil developments in Germany.

Dr. Fuchs tells how motor fuel can be made from coal and gas, and how much it will cost. You will learn how the uranium atom can be disintegrated to blast a city off the map, and whether this energy can be controlled so as to raise our standard of living to undreamed of heights. And you will find out how oil can be converted into rubber, into alcohol, and into many other products which formerly were obtained only from plant and animal life.

This is the story of oil—its past, its present, and its future.

General manager Hinderliter

George A. Hays has been appointed vice president and general manager of the Hinderliter Tool Company, a division of H. K. Porter Company, Inc., at Tulsa, Oklahoma, following the retirement of Frank J. Hinderliter who founded the company in 1920, it was announced by T. M. Evans, president. Hinderliter Tool Company manufactures oil field drilling equipment.

Hays was formerly vice president of Oil Well Supply Company, a United States Steel Corporation subsidiary. He has been associated with this company and its affiliates in various capacities since 1922.

Gray Rental Division

J. A. Gray, president of the American Iron and Machine Works Company, Oklahoma City, Oklahoma, announces that the former Gray Supply Company will be operated as the Gray Rental Division of the American Iron and Machine Works Company. The Gray Rental Division has Gulf Coast headquarters at 1801 Semmes Street, Houston, Texas, and is managed by C. D. Fitch, assisted by C. L. Braswell. The Gray Rental Division has branches at Shreveport and Harvey, Louisiana and Houston, Alice and Odessa, Texas. The firm operates a rental service on 2⅜-in., 2⅞-in., and 3½-in. drill pipe, drill collars, kellys, and pipe handling equipment. They also have blowout preventers and core barrels on rental.

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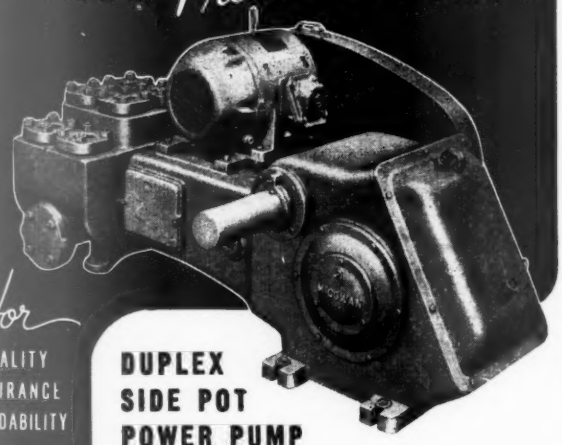

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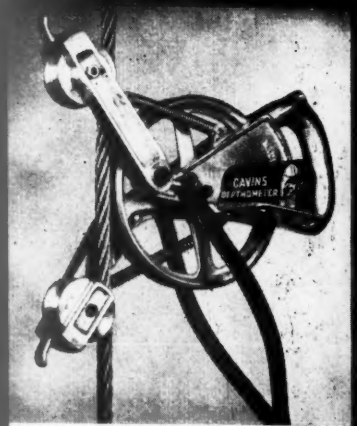

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Rubel makes challenging talk

One of the outstanding events of the Fall Meeting of the Petroleum Division of Southern California Section, AIME, held at the Ambassador Hotel in Los Angeles, October 24 and 25, was the presentation by A. C. Rubel, vice president of Union Oil Company of California, on the subject, "What Does Management Expect of Engineers?" This was a comprehensive discussion of a highly pertinent matter, delivered with the usual Rubel clarity, without pulling any punches, and loaded with sound philosophy and suggestion.

A. C. Rubel

Wasting no time on preliminaries, the speaker enumerated in orderly succession a series of management's expectations, on which he elaborated where necessary, and on the basis of which he made some final recommendations that were decidedly to the point. The various requirements itemized with amplifying remarks were briefly as follows:

(1) Management expects engineers to fit themselves to become part of management, and to be sufficiently aggressive to assume as many management responsibilities as possible.

The line of success for pure technical engineers is a broad-based cone with a very fine tip. The road to the top is long; competition is tough, and few make the grade. There is, however, unlimited opportunity in the operating departments, and the speaker expressed it as his opinion that industry could make good use of a few more presidents and vice presidents with engineering background.

(2) Management expects engineers to have sound fundamental educational background, and to supplement training with technical and practical experience in an operating department, or operating departments.

A petroleum engineer supervising coring, cementing, mud conditioning, or well completion practices, can be of maximum service only if he is familiar with the actual working details of the drilling process.

A production engineer will be better equipped to do a topnotch job if he has had prior experience on a well-pulling gang, or as a pumper or gauger, or perhaps a gas plant operator.

Engineers, being the raw material from which technical, much of the operational, and a considerable proportion of managerial and executive supervisors, are to be drawn, companies should make sure that engineers get the kind of experience that is likely to develop them in the lines for which they are best suited.

(3) Management expects engineers to learn to handle adequately the greatest of all industrial responsibilities, that is, the problem of human relations. This can be best contrived by mingling with the men on the rigs, joining in their "bull sessions," and conversing with them informally over their lunch boxes.

This one qualification is so important that if the candidate has all the technical skill in the world as far as engineering is concerned, and lacks this faculty, his chances of elevation to top management are slim.

(4) There can be no 40-hour week for the aspiring engineer. "Cement jobs, like babies, come between midnight and dawn, and most well completions, no matter how well planned, come after dark." The engineer must be there when things are happening, and because no one knows when "we core the sand contact," it means almost that he has to be there continuously at critical times, regardless of the hour of day or night. Ideas and concepts don't reveal themselves in the daylight hours either, and Rubel was strong in his recommendation that any man who seeks regular hours of employment had better stay out of engineering.

(5) Management expects engineers to think independently—not "in quotes." In oil engineering, so little is really known that there is an excellent field for original thought.

Engineers should keep up with contemporary literature, but take nothing for granted, regardless of the reputation of the author, if it cannot stand the cold searching light of reason.

Management should encourage young engineers to contribute to technical magazines, and to take part in technical discussions, when they have something of consequence to offer.

"Management has no interest in science, as such—is only interested in engineering and science—as they assist in the production of more oil at competitive costs, or the same quantity of oil at lesser costs."

For this reason, it may be expected that oil companies eventually will combine all their exploratory agents and agencies in a single "oil finding" department, headed by a man who doesn't get lost in detail, but can keep his eye on the main objective.

(6) Management expects engineers to criticize constructively, if the criticism is coupled with action. A valid criticism, and a remedial program, will find usually a receptive hearing from top management: however, engineers are advised to study the art of presentation.

"Management is human—and suffers from all the frailties—including the habit of buying what comes in pretty packages." Engineers should, therefore, develop to the best of their abilities methods of

making their proposals attractive insofar as this can be done without sacrificing accuracy or good judgment.

Good ideas are not hard to sell even to traditionally hostile management—and, if an engineer lacks the persistence and push that are required to excite sympathy for a worthwhile idea—he lacks qualities that are vital to success in his profession.

"When I was a young engineer, I had a fixed conviction that my management was singularly dumb and blind to the things that to me seemed obvious. Since I have myself reached that estate—top management—I am inclined to believe that I was not entirely wrong in my convictions."

Top management's job is difficult! Engineers deal in facts—executives in decisions. Engineers can assemble data, make due allowance for unknowns, and offer a recommendation. On the basis of this recommendation and an ethereal something called "business judgment," the executive must *decide* on a course that may cost the stockholders and his company millions of dollars.

Management expects its engineers to make decisions as easy as possible—and otherwise relieve top management of as much responsibility as possible.

(7) Management expects engineers to be civic minded. It is unfortunate that technical and scientific progress has well exceeded political and social advances. In consequence, we not only are unable to apply the results of our researches for the common good, but we are not even able to control them. In nuclear physics, for example, we have unleashed a power that we don't know how to control.

There should be more engineers on school boards, planning commissions, and public offices of various sorts, in order that we might reduce the muddling inefficiency, graft, and confusion that are now rampant.

(8) Management believes that engineers are, and management definitely wants them to be, a part of management. As such, they must give undivided loyalty to their organizations. There is no room in the engineering profession for unionization—in which the best of the group may be geared to the pace of the lowest.

Creative thinking can't be regimented, and engineers should be more concerned with opportunity than security. If they are to be a part of management, they can't serve two masters. They can't serve their companies, and be subservient to a union. If this dual interest develops, industry will be forced to set up as a buffer a new level of technical supervisors, independent of regimentation and divided affiliation.

(9) Management expects engineers to be adequately compensated for their jobs, but it is not easy to arrive at a comparable basis. Who can say whether the development engineer, drilling superintendent, production engineer, or production superintendent, contributes most to the recovery of oil?

Relative compensation can be best determined by fair, unbiased, and carefully conducted job analyses. Standardization, either by collective action or the efforts of misguided industrial relations effort, is not desirable.

In conclusion, Rubel summed up his address in the cryptic words of John Suman, vice president of Humble Oil and Refining Company, who used to tell all newly employed engineers, the young ones especially, "Your job is to get my job!" That, he thought, was about the best available expression in summary of what management expects of engineers.

Heads thermochemistry committee

The election of Dr. Frederick D. Rossini, chief of the Thermochemistry and Hydrocarbons Section of the National Bureau of Standards, as president of the Standing Committee of Thermochemistry of the International Union of Chemistry has been announced by Dr. E. U. Condon, director of the Bureau.

The Standing Committee of Thermochemistry, consisting of leading chemists from Poland, France, Belgium, Holland, and the United States is concerned with achieving international agreements for standards used in thermochemical investigations. The committee plans to hold its first post war meeting in London, July 1947.

Wilson Supply promotions

Wallace D. Wilson, president of Wilson Supply Company, has announced the following promotions within the company: R. W. Jeffrey, former secretary and treasurer, to the position of vice president; L. R. Bandy and George W. Gist, city salesmen, to the office of vice president: J. S. Roberts, assistant secretary and treasurer, to secretary and treasurer; J. W. King, auditor, to assistant treasurer, and A. L. Pippert, sales department, to assistant secretary.

Manager midwestern sales

Appointment of W. O. (Bill) Kupper as manager of middlewestern sales was announced recently by J. F. Hacker, manager, fittings division, Ladish Drop Forge Company.

A new office, which Kupper will head, has been opened at 332 South Michigan Avenue, Chicago, Illinois.

Kupper, formerly manager of southern sales for the fittings division, will direct the sale of the complete line of Ladish seamless welding fittings, forged steel fittings, and forged steel flanges in the middlewestern area.

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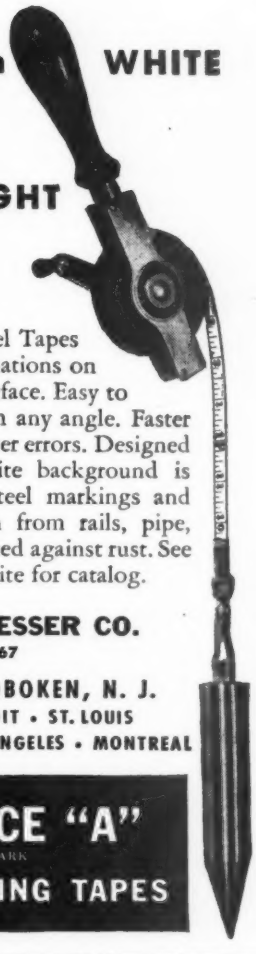

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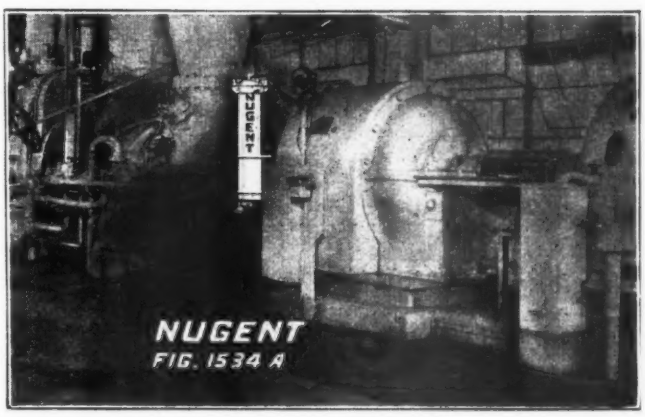

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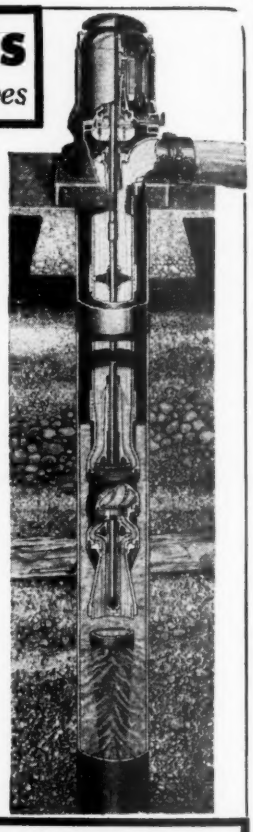

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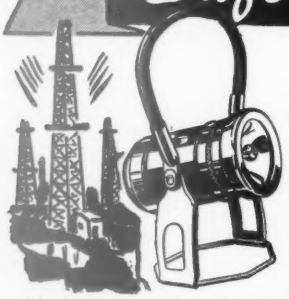

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Gas field development in France

Back from a four weeks' trip to England and the Continent, John B. O'Connor, executive vice president of Dresser Industries, Inc., reports a sizable gas field development under way in southern France and considerable activity in Czechoslovakia where he had occasion to visit a very large coal gasification plant where both synthetic gasoline and fuel oil are being made by reducing coal with oxygen. This plant is also producing relatively high B.t.u. gas from coal and piping it directly from the generators into Prague, a distance of about 100 miles.

Shortage of solid fuels in France, according to O'Connor, is providing the impetus to exploration and active development of gas fields south and west of Toulouse.

"Structure of the new fields was worked out in 1937 and the first well brought in early in January, 1939," O'Connor reports. "Today, with the war behind them, the French, through a company financed jointly by government and private capital, have completed a 12-in. pipe line to Toulouse, a 5-in. line to Tarbes, and have others under construction to neighboring industrial centers."

Two Dresser companies are already shipping equipment to the French for this program, which O'Connor believes may grow to sizable proportions. International Derrick and Equipment Company is supplying drilling equipment, and Clark Bros. Co., Inc., Olean, New York, recently completed compressors for installation in a plant erected in the St. Marcet field to extract natural gasoline from gas and deliver the dry gas by pipe line to Toulouse and intermediate points. This line, according to O'Connor, is expected to be extended later to Bordeaux and Marseilles.

Oil supplies from deeper levels

Engineering and metallurgical research on oil well drilling tools is putting greater emphasis on cutting instruments that will operate at levels far below the earth's surface, according to officials of Hughes Tool Company, Houston, Texas.

The emphasis on deep well drilling does not mean that new oil fields will not be sought, Hughes officials said, but it does mean that most of the American fields that contain oil close to the earth's surface have been tapped and the search for a continuing supply of domestic oil must go down to deeper levels.

Homer Havenstrite killed

Early in October, Los Angeles oil men were shocked to learn of the death of Homer E. Havenstrite, superintendent of the R. E. Havenstrite operations. He was en route to Wyoming on a hunting trip, when his car collided with another coming in the opposite direction—in Cajon Pass. He was killed almost instantly. Mrs. Havenstrite was also badly hurt in the accident, but is now reported to be making satisfactory progress toward recovery.

A. E. Holcomb dies

A. Elton Holcomb, widely known in the power shovel and crane industry for more than 40 years and former crane and shovel division sales manager for the Koehring Company, died in Indianapolis, Indiana, at the age of 68. Holcomb had been in ill health for a number of years.

Holcomb, active in the industry since 1905 and with Koehring since 1919, merchandised and helped develop single jackshaft steering, enclosed gearing, the self-cleaning crawler shoe, self-cleaning crawler tumbler, boomfoot shock absorber on shovels, mechanical shovel dipper trip, fully enclosed cab, finger tip control, equalizing double band clutch, front ends easily interchangeable in the field, and the independent shovel crowd.

To form own company

W. A. (Red) Davis, formerly sales manager for LeBus Rotary Tool Works, resigned from that position, effective November 1. He will form his own company and will handle the sales and distribution of oil field specialties. He will continue to represent LeBus Rotary Tool Works as agent for their oil field division, handling their line of cutting and fishing tools, whipstocking equipment and alloy steel load binders (boomers). The office address of the new company is 2375 Bolsover, Houston, Texas, telephone Lehigh 8946.

Materials Handling Exposition

The petroleum and oil industry's problems of materials handling will receive attention at the first national Materials Handling Exposition to be held at the Public Auditorium, Cleveland, January 14-17.

Executives will have the first opportunity to see and compare under one roof competing systems and machinery for materials handling. All phases of materials handling will be discussed during the four-day meeting with special consideration to problems of petroleum and oil. Production and assembly line materials handling, as well as handling for receiving, shipping, loading, and warehousing will be discussed and appropriate machinery exhibited on the exposition floor. On exhibition will be hoists, hoist mountings, cranes, derricks, conveyors, hand and power trucks, skids and pallets, tractors and trailers.

Earl I. Burke, manager of shipping, Republic Steel Company, heads the exposition's policy committee. Others on the committee are T. O. English, assistant chief purchasing agent, Aluminum Company of America, and Col. Albert B. Drake, materials handling engineer, of Drake, Stevenson, Sheahan, Barclay, Inc. of New York.

Admission to the sessions may be obtained from the Exposition Management, Clapp & Poliak, Inc., 37 Wall Street, New York, N. Y.

Helping Texas manufacturers

After 12 years of building and managing his own organization, C. K. Stillwagon, former president of Well Equipment Manufacturing Corporation, Houston, Texas, is now devoting all his efforts to helping other Texas manufacturers.

C. K. Stillwagon

Stillwagon, as president of the Texas Manufacturers Association, has launched an increasingly active program by this organization to help further build Texas industry to a par with other highly industrialized sections of the country. He is serving his first term as president of the manufacturers association. His first term as president of the organization has seen the manufacturers association greatly expand its activities to include every phase of industrial growth in Texas. The Texas Manufacturers Association is concerned with every type of Texas industry.

The Houstonian has moved his office to the M & M Building, Houston, and although his business plans for the future are still indefinite, he expects to remain active in some phase of the oil industry in addition to his work with the manufacturers association.

"I'm not retiring from business," he said. "I never intend to."

Stillwagon, who went to work in the oilfields of Pennsylvania more than 30 years ago, will also devote some of his time for the next few months to revising and expanding *Rope Chokers*, a 228-page volume of humorous anecdotes and interesting tales of the oil industry from cable tool days to the present time. The first edition of *Rope Chokers* was undertaken as a hobby by Stillwagon sometime ago and first copies were distributed several months ago to leading figures in the oil industry.

Section sales manager

John E. Slaughter, Jr., vice president of The Girdler Corporation, Louisville, Kentucky, in charge of the firm's Votator Division, has announced the appointment of Allen McKee Bond, Jr., as sales manager of Votator's fats and oils section.

Bond joined Votator's technical staff on January 1, 1946, and has had an important part in the firm's comprehensive research projects and greatly enlarged engineering service program. He was formerly research director of the Brown and Williamson Tobacco Corporation.

To prepare German reports

Dr. Warren F. Faragher of the Houdry Process Corporation has been selected by the Office of Technical Services, Technical Industrial Intelligence Division, as the U. S. Government's representative to go to Germany to supervise the preparation by Germans of final reports on the German petroleum processes. Arthur V. Danner, executive vice president of the corporation, made this announcement as Dr. Faragher departed for Europe recently.

The purpose of Dr. Faragher's mission will be to complete the collection of the German information on the programs surveyed by the U. S. Technical Oil Mission that was sent to Germany by the Petroleum Administration for War in 1945 and to have German reports prepared thereon. This group, of which Dr. Faragher was a member, followed advance troop elements to investigate German manufacturing methods of hydrogenation, catalytic cracking, hydroforming, alkylation, polymerization, Fischer-Tropsch, and other processes. At that time, the chaos resulting from the war and the displacement of German technical personnel left unanswered many of the questions concerning German methods. In the past year, however, many of the missing technicians and numerous documents have been located and from them Dr. Faragher expects to obtain the data necessary for the completion of the reports.

Dr. Faragher has been associated with Houdry Process Corporation since its formation in 1931.

Open new offices

Watts, Payne-Advertising, Inc., 205 South Cheyenne, Tulsa, Oklahoma, has announced the opening of offices in Dallas, Texas, and Wichita, Kansas. Manager of the Dallas office is Burke Gilliam.

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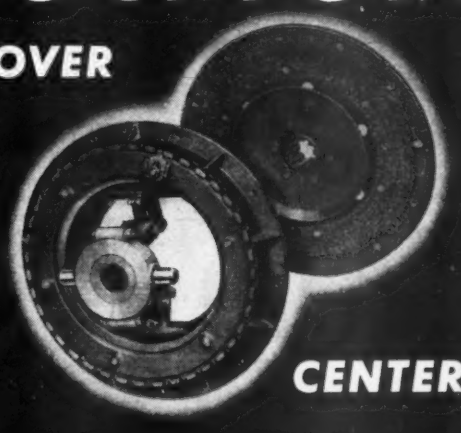

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